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WESTWARD REGION COMMERCIAL GROUNDFISH FISHERY MONITORING

INVESTIGATIONS, 1982 THROUGH 1984

By

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ALASKA DEPARTMENT OF FISH AND GAME

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Kodiak, Alaska

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ABSTRACT

The fishery monitoring activities of the Westward Region groundfish staff of the Alaska Department of Fish and Game during 1982 through 1984 are presented, as are the data collected. There were 35 observer trips on domestic trawlers and longliners in the Kodiak and the Bering Sea/Aleutians areas, yielding information on species, size, and age composition of the catch. During 1982 through 1984 port samplers collected 9,673 age structures and 55,402 length measurements, and observers collected 1,242 age structures and 10,738 length measurements. The most important areas to the trawl fishery in the Kodiak area were the eastern side of Shelikof Strait, Marmot Bay, and the Sitkalidak Island area. In the Bering Sea the most important area was in the immediate vicinity and north of Unalaska and Akutan Islands.

Estimates of fishery total catch and discard were made from the observer data. Changes in age composition by year is documented for three species, Pacific cod *(Gadus macrocephalus)*, sablefish *(Anoplopoma fimbria)*, and Pacific ocean perch *(Sebastes alutus)*. Catch per unit of effort (CPUE) information from a variety of sources is presented for the trawl fisheries.

KEY WORDS: groundfish observers, age determination, port sampling, CPUE, sablefish, Pacific cod, walleye pollock, Pacific ocean perch, incidental catch, Gulf of Alaska, Bering Sea.

INTRODUCTION

The groundfish fishery in western Alaska waters (Figure 1) has the potential to become extremely valuable to the domestic fishing industry. The current potential annual catch for the Bering Sea and Aleutian Islands is 2,000,000 metric tons (t) (Bakkala and Low 1984) and the potential for the Gulf of Alaska is over 470,000 t (North Pacific Fishery Management Council 1985). The fishery has been pursued primarily by foreign fleets in the past, but the domestic industry is expanding rapidly. The State of Alaska established in 1977 a program within the Department of Fish and Game to collect domestic groundfish fishery information.

The efforts of the State of Alaska to develop a groundfish monitoring program have been supported by contracts with other agencies to perform important aspects of the work. From 1977 through 1980 the North Pacific Fishery Management Council supported a groundfish observer program (Blackburn and Rigby 1980 and Blackburn and Owen 1980). From late 1981 through 1984 the National Marine Fisheries Service supported the fishery monitoring operations of the State of Alaska groundfish staff through two contracts, contract numbers 81-ABC-00269 and 83-ABC-00324. The objective of the contracts was to monitor the domestic groundfish fleet, providing needed biological and effort data including species and size composition, incidental species catch, discard, catch area, and effort. The Westward Region[1] groundfish staff monitored fisheries that occurred primarily in the Central and Western Gulf of Alaska[2], and the Bering Sea-Aleutian areas (Figure 1). This report is a final report of Westward Region groundfish activities supported in part by the NMFS contracts.

METHODS

The groundfish staff in the Westward Region has consisted of one full time biologist, two or three seasonal observers, and a seasonal age reader, all working out of Kodiak. Beginning in 1984 a second full time biologist was assigned to the groundfish staff. Records of fish sales are provided to the

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1 The Westward Region consists of all Alaskan waters south of the latitude of Cape Douglas and west of 150^{0} west longitude, including the Gulf of Alaska, Aleutians, and the Bering Sea, except Bristol Bay east of a line between Cape Newenham and Cape Menshikof.

2 The Central and Western Gulf of Alaska are regulatory areas used by the North Pacific Fishery Management Council for management of the groundfish fishery. The Central Gulf consists of the Kodiak and Chirikof INFC areas (Figure 1), and the Western Gulf consists of the Shumagin INPFC area. These INPFC areas were established by the International North Pacific Fisheries Commission for reporting of groundfish fishery catch statistics.

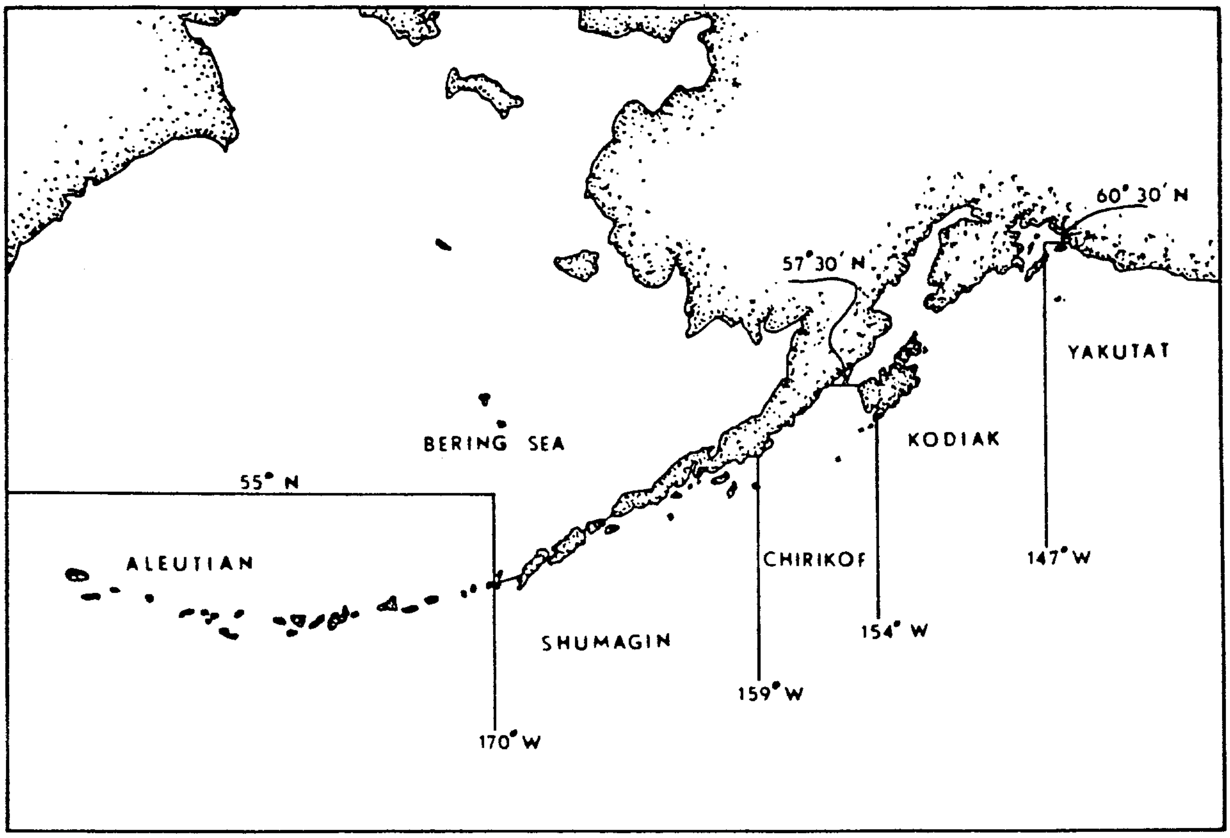


Figure 1. Boundaries of INPFC areas in the Gulf of Alaska and management areas in the Bering Sea and Aleutians are as illustrated. The Central Gulf is a regulatory area consisting of the Kodiak and Chirikof INPFC areas and the Western Gulf is a regulatory area equivalent to the Shumagin INPFC area.

Department of Fish and Game on fish tickets by the industry. Activities of the staff include summarizing fish tickets, sampling the catch for biological information, interviewing vessel captains, collecting logbook information, compilation and analysis of biological information, age determination of samples, and making trips with fishing vessels to sample the catch.

Catch Records and Fish Ticket Summaries

Reports of catch in the form of fish tickets for each individual sale are required by the State of Alaska for fish landed in Alaska or caught in state waters. Fish processors are required to prepare and submit fish tickets to the Alaska Department of Fish and Game. For fish not processed but sold as bait directly from one vessel to another, reports are required by regulations of the National Marine Fisheries Service. The selling vessel is required to prepare and submit fish tickets to ADF&G for bait sales.

Prior to 1985, fish tickets from catch areas within Westward Region boundaries were forwarded to the Kodiak office of ADF&G for processing. As fish tickets were received they were edited, entered into manually maintained catch logs, and forwarded to keypunchers for eventual entry into a computerized system. Prior to 1984, hand tabulations from the catch logs were used to monitor catch levels on an inseason basis. In 1984 fish ticket data were entered on microcomputers, and computerized summaries of Westward Region and statewide fish tickets became available for inseason catch monitoring. Various computerized summaries of fish ticket data were then available as well as hand tabulated records.

Age Determination

Information on rates of growth and mortality as well as knowledge of the age composition of exploited stocks are extremely valuable to management of fisheries. This information is obtained by age determination of fish from the fishery. An age reader position was established in Kodiak in 1980. The age reader trained with the Canadian Department of Fisheries and Oceans (CDFO) aging staff in Nanaimo. She has been an active member of the Pacific Marine Fisheries Commission (PMFC) sponsored Committee of Age Reading Experts (CARE), actively participating in workshops for methodology standardization and interagency otolith exchanges.

All age determinations were based on otoliths. Use of scales for aging Pacific cod *(Gadus macrocephalus)* was initially investigated and discarded because scales were too time consuming to collect, too difficult and time consuming to read, and did not seem to provide ages greater than about four years.

Most otoliths were broken and the newly exposed surface was gently burned in an alcohol flame until browned slightly (Chilton and Beamish 1982). This procedure accentuated differences in the composition of the otolith that were formed in the otolith as the fish grew through different seasons of the year.

The otolith was then examined with a microscope by placing it in clay to hold it upright. A drop of cooking oil was placed on the burned surface to provide better visibility. Illumination was provided by a high intensity 150 watt tungsten halogen lamp transmitted to the viewing surface by fiber optics. The magnification used depended upon the species. Pacific cod have large otoliths and relatively few years of life, making wide growth zones so that magnification of about 10 power is adequate. In contrast, sablefish *(Anoplopoma fimbria)* have small aotoliths and may be very long lived, requiring up to 100 power to separate annuli.

Even when using this break and burn technique, otolith surfaces were examined for important clues to the identification of annuli or annual growth zones. For pollock *(Theragra chalcogramma)* surface reading of the otoliths was usually adequate.

Collection of Length and Age Smples

Most of the effort for collection of length and age samples was expended at port when fish were delivered. Several different sampling strategies have been used in the past, but most consisted of a sample of the catch taken for length frequency from which a sample for age analysis was selected. Samples for age analysis have been taken randomly from the fish measured, or in a size-stratified manner from fish measured. The size-stratified sample was made by setting an upper limit on the number of fish to be sampled in each size interval, usually 10, then discarding fish which fell in intervals that were full. This method had the statistical advantages of stratification of samples and the practical advantage of obtaining larger samples of the rarer sizes. Disadvantages included the necessity of tracking how many samples had been collected by size, that the age frequency had to be calculated using the age frequency by length and the length frequency. In the event that a fishery terminated early and the sample was less complete than expected, a stratified sample was more difficult to utilize than a small random sample would have been. For long lived species, age is poorly correlated with length; and therefore, this method results in low accuracy in the estimates of age composition. Size stratified sampling was used only with Pacific cod.

Since sablefish are usually headed at sea, their otoliths are unavailable in port. In order to sample sablefish ages, we purchased heads from fishermen. Fishermen were instructed to take all the heads from the catch dressed for market from one or more sets, until they had a basket full. These samples are entirely from the commercial catch. In addition, observers made trips on sablefish longliners and took samples of otoliths from the commercial catch. Observers also sampled the discarded catch for age. All samples from sablefish were random.

Other investigators have found variability of age and length samples of groundfish landings to be related to the area fished, with both between trip differences and within trip differences. Kimura (1984) has recommended for Washington Department of Fisheries port samplers that age samples be collected from at least 10 but not more than 25 vessels during a sampling period and that individual samples be about 50 to 100 fish. Kimura (1984) found that if these guideline numbers were exceeded the information gained would be relatively small. This sampling strategy was implemented with the development of our port sampling program in 1981, based on unpublished information from Kimura. For sablefish sampling, these guidelines were implemented prior to the development of the shore-based sablefish fishery in 1984 along with the overall sampling objective of obtaining 1,000 sablefish ages from each area stratum each year. Westward Region groundfish samplers collected 100 sablefish otoliths per landing from the first 10 landings, followed by 50 per landing from the next 10 landings. Not all of these structures were read, but they provided a cushion should the fishery close early as well as extra structures with which to train age readers.

Skipper Interviews and Logbook Collection

The personnel that collected port sample data and skipper interviews routinely contacted processors and vessel skippers to track activities of the fishing fleet. When a skipper who was preparing to go fishing was contacted, a logbook was offered for his used. When vessels returned to port the logbook was collected, along with an interview to complete missing or unclear portions of the logbook. If the skipper declined to complete a logbook or did not have one, an interview was conducted to determine total effort expended during the trip, areas fished and characteristics of the gear. Tow by tow trawl data cannot be obtained through an interview without a completed logbook. These data were archived for keypunching at a later date. Virtually all the data have now been keypunched under contract number 84-4 with the North Pacific Fishery Management Council and are available in computerized form.

CPUE Calculation

CPUE calculations were based on data obtained from skipper interviews, logbooks, and on observer data. Logbook and interview data were considered usable for the trip if the total effort expended was available and if the fish ticket catch data were available.

CPUE from interviews and logbooks was calculated for each trip as the catch weight on the fish ticket divided by total effort in hours for trawlers or divided by hooks fished for longliners. Observer estimates of catch and hours trawled were used for calculation of CPUE from observer data. Results are reported as weight per hour or weight per hook.

Observer Procedures

Observers and onboard samplers made trips on domestic trawl and longline vessels which were delivering their catch to Kodiak, Dutch Harbor, Akutan, and Seward as well as vessels which were selling bait (cod and pollock) to king crab and Tanner crab fishermen on the fishing grounds in these general areas.

Observers made estimates of the total catch weight of each haul completed while they were aboard. The catch was sampled in one of two different ways; either incidental species were recorded or both incidental species and a sample of the catch were recorded. Incidental species such as halibut and crab were usually all counted, and the first 20 from each haul were sampled to determine average weight. Halibut were sampled by measuring their fork-length, and a weight-length relationship was used to estimate the weight of each fish. Samples of crab and other incidental species were weighed. The average weight was used to expand the count to a weight. A sample of the catch was often taken and sorted by species with number and weight of each species in the sample recorded. Estimates of the total catch of sampled hauls were then possible by expansion of each component appropriately. Incidental species catch was recorded on more hauls than was species composition of the total catch, and samples of incidental species were nearly always enumerated completely.

Occasionally, biological observations were made by observers. These included collections of length and age samples and examination of stomach contents, primarily of Pacific cod. Sampling methods were the same as those used at dockside, where the same types of samples were taken.

Beginning in 1984 there was considerable controversy over the impact of the trawl fishery on crab stocks. The trawlers argued that they were removing crab predators when they were catching Pacific cod and that their action could have a positive effect on the depressed crab stocks. The trawlers argued that the cod fishery has a potential for a positive effect on crab to offset the negative effect of incidental catch. The trawl fishermen insisted that information on the extent of predation on king crab should be collected by observers in order to quantify the positive and negative effects of trawling on king crab. As a cooperative effort to provide this information, the observers recorded contents of the stomachs of cod caught by trawl vessels. In addition to fish size and sex, the identity and number of each prey item was recorded from 10 fish captured in each haul.

Observer Data Analysis:

Computerized observer data were carefully edited to assure they were correct and complete.

Time and area strata were chosen to be representative of the fishery and to contain a sufficient number of observer trips to justify expansion. The fishery has been active in the immediate areas of Kodiak and Unimak Pass. These two geographically discreet areas contain nearly all the observed trips and most of the landings (Figure 2). The time blocks were chosen to be quarter years, except in 1982 in the Kodiak area where the first two quarters were combined to provide a block with a significant observer effort.

Estimates of total catch for each species were made by multiplying the total observed catch by two expansion factors, total fish ticket landings divided by fish ticket landings on observed trips and hauls made on observed trips divided by hauls sampled. Mathematical notation for these calculations and the estimates of variances are detailed below.

Let:

i = i^{th} tow observed in a particular time-area stratum

j = j^{th} species caught within stratum

a_i = weight of sample of all species on tow i

s_{ij} = weight of sample of species j on tow i; $\sum_{j=1}^{m} s_{ij} = a_i$

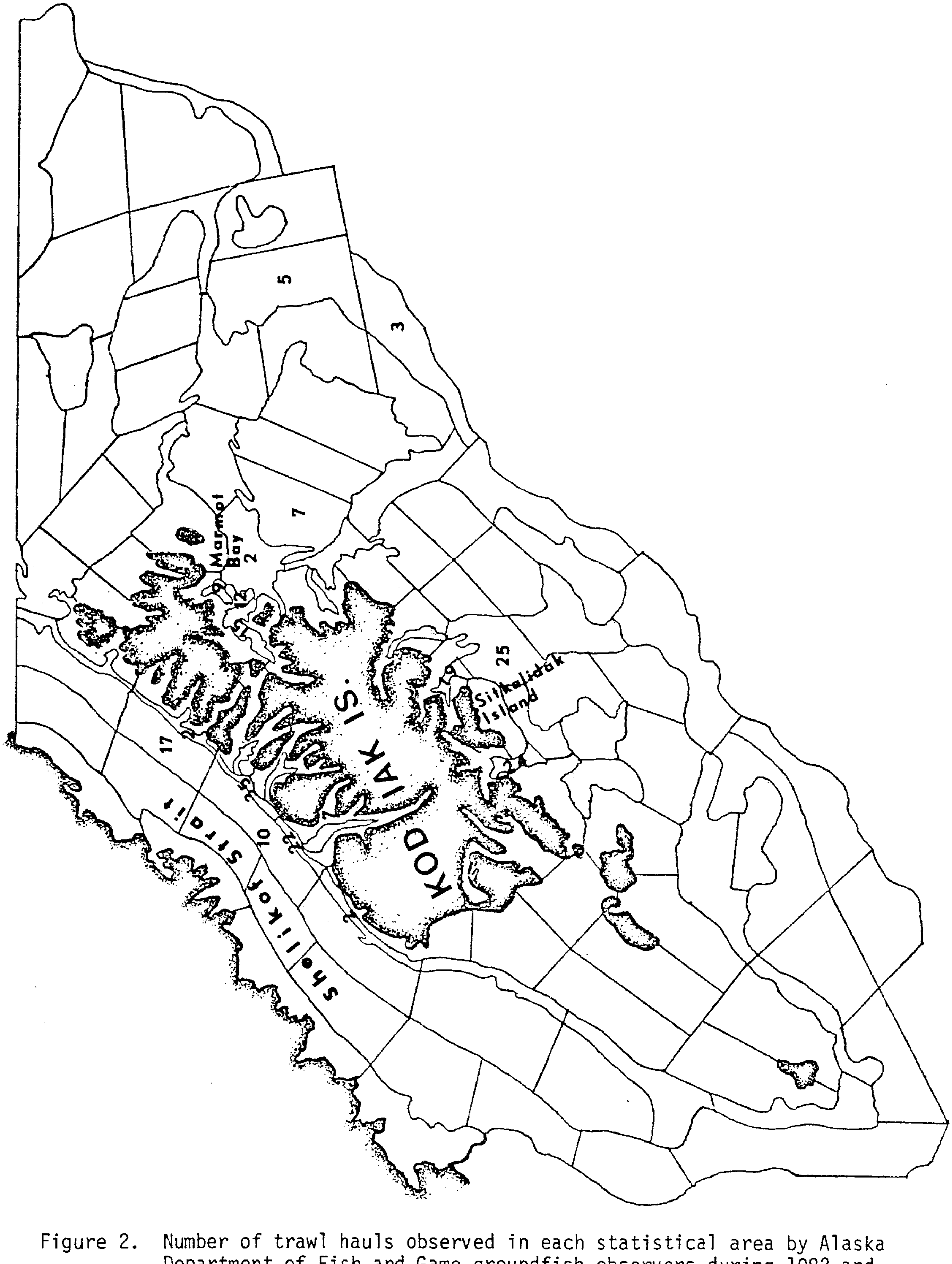


Figure 2. Number of trawl hauls observed in each statistical area by Alaska Department of Fish and Game groundfish observers during 1982 and 1984.

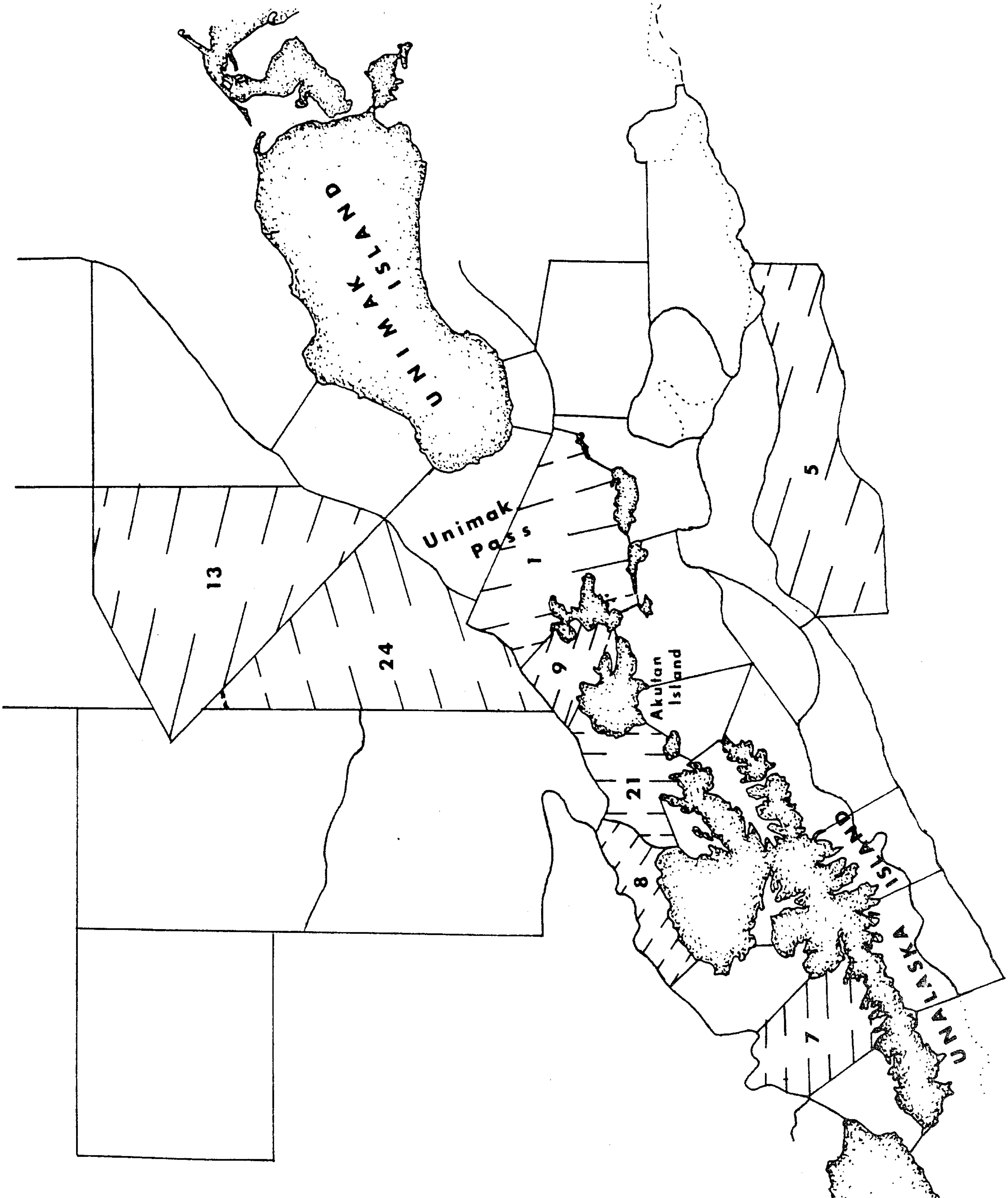


Figure 2. Number of trawl hauls observed in each statistical area by Alaska Department of Fish and Game groundfish observers during 1982 and 1984 (continued).

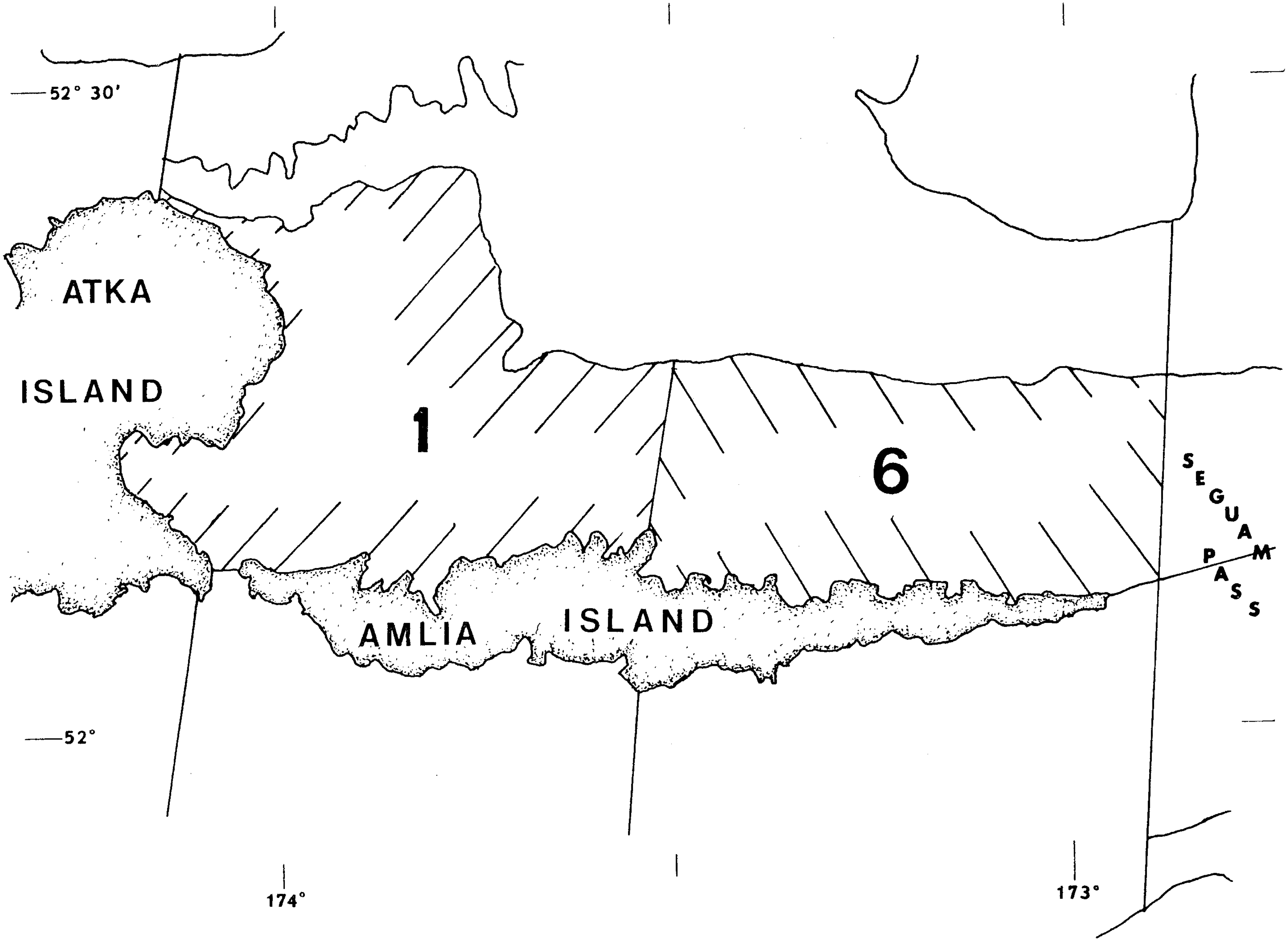


Figure 2. Number of trawl hauls observed in each statistical area by Alaska Department of Fish and Game groundfish observers during 1982 and 1984 (continued).

b_i = weight of all species in entire tow i; estimated by the observer

n_o = number of hauls (sampled and unsampled) on observed trips

n_s = number of hauls sampled on observed trips

m = number of species on observed trips

c_{ij} = catch of species j in haul i

X = catch of the target species from fish tickets from observed trips in the stratum

Y = catch of the target species from all fish tickets in the stratum which targeted on the same species as the observed trips

X_j = catch of species j from fish tickets on observed trips

Y_j = catch of species j from all fish tickets in stratum

T_j = estimated total catch of species j in stratum

D_j = estimated discard of species j in stratum

t_j = estimated total catch of species j on observed trips in the stratum

Var $(\bar{c}_j)$ = variance of c_{ij} over all tows, for species j

SE_j = standard error of the estimate for species j.

The target species was determined for each landing, and it was that species which comprised more than half of each landing. Calculations were as follows:

$$c_{ij} = s_{ij} * b_i / a_i$$

$$\bar{c}_j = \left(\sum_{i=1}^{n} c_{ij} \right)/n_s$$

$$T_j = \bar{c}_j * n_o * Y / X$$

$$D_j = T_j - Y_j$$

$$\text{Var}\ (\bar{c}_j) = \left(\sum_{i=1}^{n} (c_{ij})^2 - \left(\sum_{i=1}^{n} c_{ij} \right)^2 /n \right)/(n-1)$$

$$\text{Var}\ (T_j) = \text{Var}\ (\bar{c}_j) * [\ n_o * (Y/X)\ ]^2$$

Assumptions of these calculations are:

1. That the above expressions a_i, b_i, B_t, and B_0 are known exactly with variance. Since this is not always true the expressions provide minimum estimates of the variance.

2. That sampled hauls are a random sample of all the hauls made on a trip and adequately represent the total catch.

3. That collected samples adequately represent the species composition of the catch.

4. That observers recorded all hauls completed, regardless of whether they were sampled.

5. That observer estimates of total catch weight on each haul are not biased.

6. That the observed trips adequately represent the entire fishery.

7. That the fish tickets accurately reflect total deliveries. Specifically, that fish tickets from bait sales at sea are as accurate and as completely reported as are sales to processing plants.

The data employed had to pass several tests. A trip qualified for use in calculating total catch and discard if (1) observer coverage could be expanded to the whole trip, i.e., all hauls were counted and contained an estimate of total catch; (2) the trip occurred in one area and time block; (3) the correct fish ticket could be found for a trip, or it was known that no fish ticket existed (such as on a short trip with little or no catch); and (4) the observer estimates of catch of landed species were at least similar to values on the fish ticket.

Area and time blocks qualify for estimation of incidental catch and discard if at least three valid trips occurred within them.

Data Format

The data summarized for this report are stored in three different file types: an observer catch file; a file of individual specimen records or age, weight, and length (AWL); and a file of length frequencies. The observer data and AWL data are in RBASE 5000 files which can be downloaded to ASCII files. The length frequency data are in ASCII files. The structure of these files is provided in Appendix A. All files are on five and one quarter inch floppy disks in a form read by an IBM pc/xt or compatible microcomputer. Both the computerized data files and the original data sheets are archived in the Kodiak office of the Alaska Department of Fish and Game.

RESULTS

Data Collection Activities

During 1982 through 1984 port samplers collected 9,673 age structures and 55,402 length measurements and observers collected 1,242 age structures and 10,738 length measurements (Table 1). These collections included 20 species and came from landings made in four ports, Kodiak, Akutan, Dutch Harbor, and Sand Point.

There were 35 separately numbered observer trips completed during 1982 through 1984 (Table 2). Trips on trawl vessels during the first half of the year accounted for 30 of these while there were three trips on trawl vessels in the last half of the year and two trips on sablefish longline vessels.

Locations of Observed Hauls

The areas fished on observed trips in 1982 and 1984 were in the vicinity of Kodiak Island, Unimak Pass, and Seguam Pass (Figure 2). Individual hauls in the Kodiak area tended to be clustered in three general areas, the eastern side of Shelikof Strait, Marmot Bay, and near Sitkalidak Island. In the Unimak Pass area the observed hauls were widely distributed north of the Aleutian Islands with five hauls south of Unimak Pass.

Fishery Total Catch and Discard Estimates

There were four time by area blocks in which estimation of total catch and discard by the fishery was completed. These were the first quarter of 1984 for the Bering Sea (Table 3), the first and second quarters of 1982 for the Bering Sea (Table 4), the first quarter of 1984 for Kodiak (Table 5), and the first two quarters of 1982 for Kodiak (Table 6). The first two quarters of 1982 were combined in both the Kodiak and Bering Sea areas because of the temporal distribution of the trips; in the Kodiak area there was one trip in January and four trips from 28 March through 30 April while in the Bering Sea there were two trips in March, two in April, and one beginning in March and ending in April.

Calculation of total catch and discard was done in several ways. It was necessary to separate the fishery by target species in the Kodiak area in order to minimize the variance of the estimates of catch. It would have been desirable to also separate geographic areas had the number of observer trips been sufficiently large.

The precision of the estimate of total catch varies among the species, as indicated by the minimum standard error of the estimate, which ranges from a low of 11% for halibut (Table 3) to 100% (Tables 3 through 6). The precision is greatest (lowest percent standard error) for the target species and for halibut. The precision is lower for species that occurred less frequently, with a minimum of 100% of the estimate when the species was taken only once in the set of samples. Since the catches of the groundfish and miscellaneous species were estimates from subsamples of a portion of the hauls while the incidental species were usually all counted in all hauls, there was less variability in the estimates of the incidental species total catch.

Table 1. Age structures and length measurements collected during 1982 through 1984, by species, source, port, and quarter year.

Species	Age samples		Length measurements	
	Port	Observer	Port	Observer
Kodiak Quarter 1, 1982				
Pollock	250		2186	222
Cod	50	30	175	30
Pacific Ocean perch	32		36	
Dusky rockfish	16		18	
Rougheye rockfish	16		16	
Redbanded rockfish	1		1	
Halibut				54
Kodiak Quarter 2, 1982				
Pollock	75	30	278	588
Cod	173	90	173	143
Sablefish				5
Halibut				89
King salmon				6
Pacific Ocean perch	57		83	
Northern rockfish	2		6	
Dusky rockfish			2	
Kodiak Quarter 4, 1982				
Pollock	270		1650	
Cod	70		1482	
Kodiak Quarter 1, 1983				
Pollock	31		137	
Cod	213		1627	
Kodiak Quarter 2, 1983				
Cod	552		2879	
Sablefish	20		93	
Flathead sole	150		884	
Pacific Ocean perch	1			
Dusky rockfish	4			
Rougheye rockfish			150	
Shortspine thornyhead	15		67	
Kodiak Quarter 3, 1983				
Pollock	50			
Sablefish	279		208	
Kodiak Quarter 4, 1983				
Cod	783		7665	
Sablefish			73	
Black rockfish	19		156	

-Continued-

Table 1. Age structures and length measurements collected during 1982 through 1984, by species, source, port, and quarter year (continued).

Species	Age samples Port	Age samples Observer	Length measurements Port	Length measurements Observer
Kodiak Quarter 4, 1983				
Dusky rockfish	1		18	
Kodiak Quarter 1, 1984				
Cod	470		4424	
Pollock				250
Flathead sole	236		1590	
Rocksole	181		953	
Yellowfin sole	27		126	
Rex sole			18	
Buttersole			184	
Starry flounder			128	
Alaska plaice			16	
Halibut				675
Kodiak Quarter 2, 1984				
Cod	430		2005	
Sablefish	198	100		50
Rocksole	150		420	
Flathead sole	249		1554	
Buttersole			132	
Sandsole			50	
Black rockfish	158		524	
Dusky rockfish	57		183	
Pacific Ocean perch	133		133	
Halibut				1303
Kodiak Quarter 3, 1984				
Sablefish	848	160		
Halibut				4
Kodiak Quarter 4, 1984				
Cod	585		3380	
Black rockfish	191		191	
Dusky rockfish	21		21	
Sablefish*	200			
Halibut				113
Dutch Harbor/Akutan Quarter 1, 1982				
Cod		101	130	270
Halibut				84
King salmon				2

-Continued-

Table 1. Age structures and length measurements collected during 1982 through 1984, by species, source, port, and quarter year (continued).

Species	Age samples Port	Age samples Observer	Length measurements Port	Length measurements Observer
Dutch Harbor/Akutan Quarter 2, 1982				
Cod		84		301
Halibut				66
King salmon				1
Dutch Harbor/Akutan Quarter 4, 1982				
Cod	515		3513	
Sablefish	10			
Halibut				130
Dutch Harbor/Akutan Quarter 1, 1983				
Cod	600		6959	
Dutch Harbor/Akutan Quarter 2, 1983				
Cod	96	404	813	3247
Dutch Harbor/Akutan Quarter 1, 1984				
Cod	490	139	6421	1827
Pacific Ocean perch	27	104	27	104
Halibut				1116
King salmon				5
Dutch Harbor/Akutan Quarter 4, 1984				
Cod	381		1105	
Pacific Ocean perch	290		290	
Halibut				102

* Samples collected at Sand Point, Alaska.

Table 2. List of trips observed aboard domestic trawlers and longliners during 1982, 1983, and 1984 by Alaska Department of Fish and Game groundfish observers.

Trip #	Date	Area	Hauls	Comment
		BERING SEA		
328	Mar 23, 1982	N&W Akutan I	2	Partial trip
329	Mar 26, 1982	N Unalaska I	10	
	Mar 28, 1982			
330	Mar 31, 1982	Seguam Pass	11	
	Apr 4, 1982			
331	Apr 10, 1982	N Unalaska I	5	
	Apr 11, 1982			
332	Apr 12, 1982	N Unalaska I	2	
605	Dec 9, 1982	N Akutan I	14	No species
	Dec 12, 1982			composition
606	Feb 21, 1983	NW Unimak I	17	
	Feb 23, 1983			
---	May 25, 1983	N Alaska	11	Cod end
	May 31, 1983	Peninsula		deliveries
8410	Jan 3, 1984	N&W Akutan I	19	5 deliveries
	Jan 12, 1984			Portuguese J. V.
8411	Jan 14, 1984	N Akutan I.	20	3 deliveries
	Jan 18, 1984	Unimak P.		Portuguese J. V.
8412	Jan 19, 1984	NE Unalaska I	3	Partial trip
8403	Jan 26, 1984	NE Unalaska I	4	
	Jan 27, 1984	NW Unimak I		
8404	Feb 1, 1984	N&W Akutan I	4	
	Feb 2, 1984			
8405	Feb 16, 1984	NE Unalaska I	6	
	Feb 17, 1984			
8406	Feb 23, 1984	NW Unimak I	2	
8407	Mar 8, 1984	N&W Akutan I	7	
	Mar 10, 1984			
8421	Oct 25, 1984	Davidson Bank	6	
	Oct 26, 1984	N Unalaska I		
		KODIAK AREA		
414	Jan 29, 1982	Shelikof	8	
	Jan 30, 1982			
415	Mar 28, 1982	Shelikof	11	
	Mar 31, 1982	Sitkalidak*		
416	Apr 7, 1982	Sitkalidak*	11	
	Apr 9, 1982			
417	Apr 18, 1982	Shelikof	8	
	Apr 21, 1982			
418	Apr 25, 1982	Sitkalidak	30	
	May 1, 1982			
8408	Mar 16, 1984	Sitkalidak*	15	
	Mar 21, 1984			

-Continued-

Table 2. List of trips observed aboard domestic trawlers and longliners during 1982, 1983, and 1984 by Alaska Department of Fish and Game groundfish observers (continued).

Trip #	Date	Area	Hauls	Comments
8409	Mar 19, 1984	Shelikof	18	
	Mar 23, 1984	Marmot		offshore
8401	Mar 2, 1984	Shelikof	14	
	Mar 4, 1984			
8402	Mar 9, 1984	Sitkalidak*	7	
	Mar 11, 1984			
8413	Mar 31, 1984	Shelikof	17	
	Apr 3, 1984			
8414	Apr 11, 1984	Marmot	8	
	Apr 13, 1984			
8415	Apr 19, 1984	Marmot	10	
	Apr 24, 1984			
8416	Apr 21, 1984	Marmot	21	
	Apr 26, 1984	Shelikof		
8417	May 4, 1984	Marmot	12	
	May 7, 1984	Shelikof		
8418	May 12, 1984	Shelikof	11	delivery < 10% of
	May 14, 1984			observed catch
8422	Dec 3, 1984	Shelikof	13	
	Dec 6, 1984			
	Longline	Observer		Trips
8419	Jun 15, 1984	East of	21	Sablefish
	Jun 26, 1984	Kodiak		
8420	Aug 2, 1984	East of	18	Sablefish,
	Aug 15, 1984	Kodiak		2 landings

* Off the north end of Sitkalidak Island, usually referred to as Barnabas, after the cape at that location.

Table 3. Estimate of incidental catch and discard in pounds from the trawl fishery for groundfish in the Bering Sea during the first quarter of 1984, from Alaska Department of Fish and Game groundfish fishery observer data. This is for the segment of the fishery for which the reported cod landing was greater than the reported landing of any other species. The standard error or the estimated catch is expressed as a percentage of the estimate.

Species	Catch Estimated in Fishery	Std Error of Estimate, %	Fishery Landings	Estimated Discard
		Incidental Catch		
Halibut	584,655	11	0	584,655
Tanner crab	2,763	45	0	2,763
King crab	0	-	0	0
King salmon	2,093	37	0	2,093
Silver salmon	215	100	0	215
		Groundfish and Miscellaneous Catch		
Pacific cod	18,566,610	24	20,596,690	-2,030,080
Pollock	695,569	49	12,150	683,419
Sablefish	26,915	100	0	26,915
Pacific Ocean perch	822	100	0	822
Rougheye rkfish	292	100	0	292
Yelloweye rockfish	2,046	100	0	2,046
Flathead sole	212,665	26	0	212,665
Rocksole	85,014	41	0	85,014
Rex sole	120,010	33	0	120,010
Arrowtooth flounder	219,979	22	0	219,979
Skate sp.	29,564	70	0	29,564
Big skate	8,346	100	0	8,346
Sleeper shark	16,620	100	0	16,620
Spiny dogfish	365	100	0	365
Sculpin spp.	28,978	65	0	28,978
Bigmouth sculpin	2,052	100	0	2,052
Great sculpin	134,798	61	0	134,798
Yellow Irish Lord	242,201	36	0	242,201
Korean hair crab	15,474	63	0	15,474
Basket star	777	100	0	777
Squid spp.	9,680	76	0	9,680
Sponge	567	100	0	567

Pounds of cod sold from observed trips 737,621
Pounds of cod in fishery 20,596,690
For 3.6% Observer coverage by fish ticket weights

Table 4. Estimate of incidental catch and discard in pounds from the trawl fishery for groundfish in the Bering Sea during the first and second quarters of 1982, from Alaska Department of Fish and Game groundfish fishery observer data. This is for the segment of the fishery for which the reported cod landing was greater than the reported landing of any other species. The standard error of the estimated catch is expressed as a percentage of the estimate.

Species	Catch Estimated in Fishery	Std Error of Estimate, %	Fishery Landings	Estimated Discard
		Incidental Catch		
Halibut	40,430	14	0	40,430
Tanner crab	158	100	0	158
King crab	0	-	0	0
King Salmon	1,978	55	0	1,978
	Groundfish and Miscellaneous Species Catch			
Cod	13,502,420	15	12,903,629	598,791
Pollock	1,059,853	61	2,550	1,057,303
Sablefish	0	-	0	0
Northern rockfish	3,728	100	0	3,728
Flathead sole	1,762	100	0	1,762
Rocksole	381,701	42	0	381,701
Rex sole	1,205	100	0	1,205
English sole	1,762	100	0	1,762
Arrowtooth flounder	31,915	62	0	31.915
Atka mackerel	1,629,437	52	0	1,629,437
Great sculpin	631,502	48	0	631,502
Yellow Irish Lord	44,665	28	0	44,665
Korean hair crab	3,616	100	0	3,616
Coral	1,536	100	0	1,536
Sponge	3,214	69	0	3,214
Starfish	1,828	69	0	1,828
Basket starfish	2,807	81	0	2,807
Snail	1,110	100	0	1,110
Sea pen	819	100	0	819
Miscellaneous	10,277	67	0	10,277

Pounds of cod sold from observed trips 150,515
Pounds of cod in fishery 12,903,629
For 1.2% coverage by observers by fish ticket weights

* Sold as the species group Pacific ocean perch.

Table 5. Estimate of incidental catch and discard in pounds from the trawl fishery for groundfish in the Kodiak INPFC area during the first quarter of 1984, from Alaska Department of Fish and Game groundfish fishery observer data. This is for the segment of the fishery for which the reported cod landing was greater than the reported landing of pollock. The standard error of the estimated catch is expressed as a percentage of the estimate.

Species	Catch Estimated in Fishery	Std Error of Estimate, %	Fishery Landings	Estimated Discard
		Incidental Catch		
Halibut	118,583	18	0	118,583
Tanner Crab	2,860	68	0	2,860
King Crab	745	100	0	745
King Salmon	4,636	50	0	4,636
		Groundfish and Miscellaneous Catch		
Pacific cod	3,884,245	12	3,167,368	716,877
Pollock	187,373	25	716,099	-528,726
Sablefish	8,636	74	10,359	-1,723
Atka mackerel	1,585	55	0	1,585
Pacific Ocean Perch	5,719	82		
Northern rockfish	184	67		
Yelloweye rockfish	1,507	97	420*	12,051
Harlequin rockfish	4,047	99		
Dusky Rockfish	1,014	40		
Shortspine Thornyhead	1,668	100	0	1,668
Flathead sole	116,983	24		
Rocksole	277,969	23		
Rex sole	45,615	44		
Alaska Plaice	12,967	47		
Dover sole	4,985	80	159,396*	334,366
English sole	7,006	46		
Butter sole	3,375	100		
Yellowfin sole	4,660	85		
Starry Flounder	20,202	59		
Arrowtooth Flounder	258,716	22	0	258,716
Skate spp.	20,847	41	0	20,847
Prowfish	138	70	0	138
Sculpin spp.	101,593	29	0	101,593
Bigmouth sculpin	7,178	65	0	7,178
Poacher spp.	3	100	0	3

-Continued-

Table 5. Estimate of incidental catch and discard in pounds from the trawl fishery for groundfish in the Kodiak INPFC area during the first quarter of 1984, from Alaska Department of Fish and Game groundfish fishery observer data. This is for the segment of the fishery for which the reported cod landing was greater than the reported landing of pollock. The standard error of the estimated catch is expressed as a percentage of the estimate (continued).

Species	Catch Estimated in Fishery	Std Error of Estimate, %	Fishery Landings	Estimated Discard
Snailfish spp.	118	100	0	118
Lingcod	79	72	0	79
Herring	10	100	0	10
Giant Wrymouth	819	70	0	819
Dungeness crab	43	100	0	43
Sea Anemonie	1,635	100	0	1,635
Octopus	1,060	66	?**	
Misc. invertebrates	362	100	0	362

Pounds sold from observed trips 218,316
Pounds of cod in fishery 3,167,368
For 6.9% observer coverage by fish tickets

* Rockfish and flounder were reported as species groups on fish tickets.
** Trawl caught octopus is often sold but amounts are not known for this data set.

Table 6. Estimate of incidental catch and discard in pounds from the trawl fishery for groundfish in the Kodiak INPFC area during the first and second quarters of 1982, from Alaska Department of Fish and Game groundfish fishery observer data. This is for the segment of the fishery for which the reported pollock landing was greater than the reported landing of cod. The standard error of the estimated catch is expressed as a percentage of the estimate.

Species	Catch Estimated in Fishery	Std Error of Estimate, %	Fishery Landings	Estimated Discard
		Incidental Catch		
Halibut	20,574	21	0	20,574
Tanner crab	23,055	19	0	23,055
King crab	1,502	28	0	1,502
King salmon	410	66	0	410
		Groundfish and Miscellaneous Catch		
Cod	221,609	26	431,823	-210,214
Pollock	3,165,879	14	2,107,388	1,058,491
Sablefish	697	58	9,480	-8,783
Pacific Ocean perch	6,272	52		
Rougheye rockfish	2,580	70	2,950*	8,678
Redbanded rockfish	329	100		
Dusky rockfish	2,447	52		
Flathead sole	67,303	25		
Rock sole	24,102	39		
Alaska plaice	3,331	58		
Yellowfin sole	10,094	37	1,604	115,549
Butter sole	8,087	49		
Dover sole	3,268	52		
Rex sole	968	79		
Arrowtooth flounder	114,127	36	0	114,127
Atka Mackerel	1,115	100	0	1,115
Smooth lumpsucker	2,959	100	0	2,959
Eulachon	3,536	39	0	3,536
Spinyhead sculpin	4,606	33		
Bigmouth sculpin	2,461	74	4,297	31,206
Yellow Irish Lord	11,792	41		
Great sculpin	16,644	70		

-Continued-

Table 6. Estimate of incidental catch and discard in pounds from the trawl fishery for groundfish in the Kodiak INPFC area during the first and second quarters of 1982, from Alaska Department of Fish and Game groundfish fishery observer data. This is for the segment of the fishery for which the reported pollock landing was greater than the reported landing of cod. The standard error of the estimated catch is expressed as a percentage of the estimate (continued).

Species	Pounds Estimated in Fishery	Std Error of Estimate, %	Fishery Landings	Estimated Discard
Herring	1,511	100	0	1,511
Big skate	33,936	68	\ 45,487	-10,221
Longnose skate	1,330	100	/	
Sturgeon poacher	941	56	0	941
Whitespotted greenling	516	74	0	516
Searcher	128	100	0	128
Basket starfish	509	62	0	509
Octopus	2,287	100	?**	
Dungeness crab	32	77	0	32
Lyre crab	25	100	0	25
Sidestripe shrimp	709	45	0	709
Pink shrimp	1,997	39	0	1,997
Sand dollars	402	44	0	402
Snail	259	60	0	259
Barnacles	772	100	0	772
Jellyfish	9,599	80	0	9,599
Sea anemonie	4,454	63	0	4,454
Sea slug	222	70	0	222
Miscellaneous	1,312	86	0	1,312

Pounds of pollock sold from observed trips 239,126
Pounds of pollock in fishery 2,107,388
For 11.4% Observer coverage by fish ticket weights

* Flounders, Pacific Ocean perch, skate and sculpin are sold as species groups.
** Trawl caught octopus is often sold but amounts are not known for this data set.

The discard was estimated by subtracting the fishery landings from the observers estimate of total catch of each species on observed trips and expanding this into the total fishery based on the fraction observed. Any estimate of the accuracy of the estimate of discard would be based on the accuracy of the estimate of total catch. Discard is about the same magnitude as the standard error of the estimate of the total catch, consequently the estimate of discard for any species that was sold is relatively imprecise. For example, in Table 3 the total catch of Pacific cod by the fishery as estimated by observer data was 18,566,610 lb (8,421 t) with a standard error of plus or minus 24%, or plus or minus 4,456,000 lb (2,022 t). In other words, the estimate of the catch was 14,110,000 lb (6,400 t) to 23,022,596 lb (10,443 t). To estimate the discard, the fishery landings of 20,596,690 lb (9,342 t) were subtracted from the point estimate of 18,566,610 lb (8,421 t), yielding a negative discard of 2,030,080 lb (921 t), plus or minus 4,456,000 lb (2,022 t).

Within the four area-time blocks in which estimates of discard were made there were several instances of negative discard. This is a manifestation to some extent, of the variability discussed in the previous paragraph. When the negative discard appears for the target species, it is an indication of underestimates of total catch by the observers; that is, the fish tickets from all observed trips totaled more catch than the observers estimated on those trips. When there is a negative discard of a non-target species such as pollock or Pacific ocean perch *(Sebastes alutus)*, it indicates that one or more unobserved vessels had a higher catch rate for that species than the observed vessels, either by chance or by targeting. The different explanation stems from the fact that catches of species such as Pacific ocean perch were small on observed trips and may be much higher on unobserved vessels, especially if some vessels were targeting on that species.

In the winter Unimak Pass cod fishery no king crab were observed caught in the two time periods for which sufficient data existed (Tables 3 and 4). Estimated total catches of Tanner crab and salmon were each about a ton or less in each time period (Tables 3 and 4). The estimated incidental catch rate for halibut (calculated as observed estimate of halibut catch divided by observed estimate of total catch of all species) was 0.23% in 1982 and 2.72% in 1984.

In the Kodiak area the estimated total catch of king crab and king salmon ranged from 0.2 to 2 tons in the 1982 and 1984 time periods (Tables 5 and 6). The incidental catch of Tanner crab was about 23,000 lb (10.4 t) in 1982 but less than 3,000 lb (1.3 t) in 1984 (Tables 5 and 6). Catches of halibut were about 20,000 lb (9.1 t) and 118,000 lb (53.5 t) in the two time periods (Tables 5 and 6). Percent of total catches in 1982 and 1984 were, respectively, 0.72% and 2.28% halibut; 0.92% and 0.05% Tanner crab; 0.03% and 0.01% king crab; and 0.008% and 0.09% king salmon.

Size distributions of halibut taken incidentally to the trawl fishery and the longline fishery are shown in Table 7. Most of the halibut caught by trawl were below commercial size limit, which is 81.3 cm; but those taken by longline were larger than the commercial size limit.

Table 7. Length frequencies of halibut from observer data collected in 1984, by gear, area, and quarter year.

Length	Trawl					Longline
	Bering Sea		Kodiak			
	Qtr 1	Qtr 4	Qtr 1	Qtr 2	Qtr 4	Kodiak
28			2	1		
33	4		30	7		
38	22		129	95		
43	138	6	161	193	5	
48	363	11	119	210	7	
53	245	13	63	201	6	
58	153	23	47	170	13	
63	94	22	42	90	14	
68	30	8	30	81	10	
73	27	7	21	49	19	
78	16	4	7	33	15	
83	7	5	7	31	9	1
88	4		2	19	6	1
93	3	1	3	17	4	1
98	1	2	6	16	4	1
103	1			14		2
108	2		2	9		
113	1			3		4
118	1			4		10
123	1			4		2
128	1		1	2		6
133				1	1	2
138	1		2	3		4
143				2		2
148				3		
153						
158				2		
163			1	3		
168				2		1
173				1		
178						
183						
188				2		
193	1					
198				1		
203						
208				1		
Total	1116	102	675	1270	113	37
Mean	53.7	61.1	50.3	59.1	70.1	121.2

Observer Catch Composition and CPUE

The percent composition of the catches and the CPUE of each species recorded in each area and time block is presented in Tables 8 through 13. These tables include the longline catches (Table 13), which were excluded from the tables of estimated fishery total catch and discard because the number of vessels rendered the data confidential (less than three vessels per stratum).

Fishery CPUE

Sablefish catch per unit of effort data from skipper interviews are available for 1983 and 1984. There were nine usable sablefish logbooks or skipper interviews collected in 1983 and 33 usaable interviews from 1984. These interviews represented 20.5 and 22.2% of the landed weight in the Central Gulf of Alaska in 1983 and 1984, respectively. The catch rates averaged 0.36 lb (0.16 kg) round weight per hook in 1983 and increased considerably to 1.04 lb (0.47 kg) round weight per hook in 1984. There were several changes which could have contributed to the increase in catch rate between 1983 and 1984. The market for small fish increased considerably in 1984; the abundance of small fish was high, which together with the increased market for small fish woud increase the supply; and new technology was being introduced into the longline fishery in the form of circle hooks which are reputed to be more efficient than the traditional 'J' hook.

The CPUE data indicate that the increased catch rate was due to increased availability of marketable fish and not due to the change to circle hooks. In 1983, all of the interviewed fishermen used J hooks while in 1984 both hook types were reported, but with no significant difference in the catch rate (1.06 lb/circle hook vs 1.14 lb/J hook). The differences in the catch rates between 1983 and 1984 are highly significant ($p<.001$).

Catch per unit of effort data from the trawl fishery for Pacific cod contains prominent seasonal features (Table 14). The experience in the Kodiak area, obtained through interviews, has been that very high catch rates exist during February, March, and early April, when the cod contain large gonads and apparently aggregate prior to spawning. Catch rates decline to very low rates, literally overnight, during April. The time of the decline has been reported to be as late as about 22 April, and in 1982, it occurred late in the week ending 2 April (Table 14). The extent of the decline in CPUE has been underestimated by the data because a significant portion of the effort has been totally unsuccessful after the decline; hence, it is not reported. Often fishermen cease fishing this time.

The CPUE data (Table 14) reflect the decline in catch rate during April-May and show a steady catch rate during the summer and autumn months. Differences between years are not apparent nor are differences between the Kodiak area and the Bering Sea.

Age Determination

Validation of methods is an important aspect of age determination of fishes (Beamish and McFarlane 1983). Consequently, the following species presentations are prefaced with a discussion of the efforts made and information available on the accuracy and precision of age data reported

Table 8. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the first quarter of 1982, by area and species.

Species	Observed Catch		CPUE		Percent Composition	
	Kodiak	Bering Sea	Kodiak	Bering Sea	Kodiak	Bering Sea
Tanner crab	674		21.1	0.0	0.8	0.0
Korean hair crab		17	0.0	1.4	0.0	.0
Dungeness crab	2		0.0	0.0	.0	0.0
Red king crab	34		1.1	0.0	.0	0.0
Sidestripe shrimp	33		1.0	0.0	.0	0.0
Pink shrimp	49		1.5	0.0	0.1	0.0
Big skate	1,594		50.0	0.0	2.0	0.0
Longnose skate	63		2.0	0.0	0.1	0.0
Halibut	579	81	18.2	6.4	0.7	0.2
Flathead sole	687		21.5	0.0	0.9	0.0
Rock sole	137	483	4.3	31.8	0.2	1.3
Rex sole	43	6	1.3	0.5	0.1	.0
Alaska plaice	156		4.9	0.0	0.2	0.0
Dover sole	114		3.6	0.0	0.1	0.0
Yellowfin sole	273		8.6	0.0	0.3	0.0
Arrowtooth flounder	5,247		164.5	0.0	6.5	0.0
Pollock	63,880	2,043	2,002.5	161.3	79.4	5.5
Cod	5,218	33,514	163.6	2,645.8	6.5	90.1
Sablefish	33		1.0	0.0	.0	0.0
Atka mackerel	52	577	1.6	45.5	0.1	1.6
King salmon	2	3	0.1	0.2	.0	.0
Pacific ocean perch	295		9.2	0.0	0.4	0.0
Northern rockfish		18	0.0	1.4	0.0	.0
Rougheye rockfish	121		3.8	0.0	0.2	0.0
Redbanded rockfish	15		0.5	0.0	.0	0.0
Dusky rockfish	115		3.6	0.0	0.1	0.0
Spinyhead sculpin	92		2.9	0.0	0.1	0.0
Bigmouth sculpin	78		2.4	0.0	0.1	0.0
Great sculpin	12	461	0.4	36.4	.0	1.2
Yellow Irish Lord	27	29	0.8	2.3	.0	0.1
Sturgeon poacher	15		0.5	0.0	.0	0.0
Smooth lumpsucker	139		4.4	0.0	0.2	0.0
Eulachon	166		5.2	0.0	0.2	0.0
Basket starfish		11	0.0	0.8	.0	0.0
Snail	6	6	0.2	0.5	0.0	0.0
Jellyfish	91		2.9	0.0	0.1	0.0
Sanddollars	14		0.4	0.0	.0	0.0
Barnacles	36	6	1.1	0.5	.0	.0
Sea anemonie	187	1	5.9	0.1	0.2	.0
Nudibranch	10		0.3	0.0	.0	0.0
Octopus	107		3.4	0.0	0.1	0.0

-Continued-

Table 8. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the first quarter of 1982, by area and species (continued).

	Observed Catch		CPUE		Percent Composition	
Species	Kodiak	Bering Sea	Kodiak	Bering Sea	Kodiak	Bering Sea
Sponge		7	0.0	0.5	0.0	.0
Fish parts	3		0.1	0.0	.0	0.0
Hours	31.9	12.7				
Hauls	17	9				

Table 9. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the second quarter of 1982, by area and species.

	Observed Catch		CPUE		Percent Composition	
Species	Kodiak	Bering Sea	Kodiak	Bering Sea	Kodiak	Bering Sea
Tanner crab	1,429		14.5	0.0	0.9	0.0
Lyre crab	1		.0	0.0	.0	0.0
Red king crab	45		0.5	0.0	.0	0.0
Shrimp spp.	3		0.0	0.0	.0	0.0
Pink shrimp	74		0.7	0.0	.0	0.0
Halibut	844	114	8.5	5.4	0.6	0.3
Flathead sole	4,296	8	43.5	0.4	2.8	.0
Rock sole	1,086	1,358	11.0	64.3	0.7	3.5
Rex sole	4		0.0	0.0	.0	0.0
Alaska plaice	171		1.7	0.0	0.1	0.0
Dover sole	39		0.4	0.0	.0	0.0
English sole		8	0.0	0.4	0.0	.0
Butter sole	611		6.2	0.0	0.4	0.0
Yellowfin sole	529		5.4	0.0	0.3	0.0
Arrowtooth flounder	173	152	1.7	7.2	0.1	0.4
Starry flounder	812		8.2	0.0	0.5	0.0
Pollock	95,931	3,018	971.0	142.9	63.0	7.8
Cod	35,867	31,238	363.0	1,479.3	23.6	80.8
Sablefish	65		0.7	0.0	.0	0.0
Atka mackerel		7,192	0.0	340.6	0.0	18.6
King salmon	18	7	0.2	.3	.0	.0
Searcher	6		0.1	0.0	.0	0.0
Wattled eelpout	13		0.1	0.0	.0	0.0
Rougheye rockfish	5		0.1	0.0	.0	0.0
Whitespotted greenling	24		0.2	0.0	.0	0.0
Spinyhead sculpin	168		1.7	0.0	0.1	0.0
Bigmouth sculpin	38		0.4	0.0	.0	0.0
Great sculpin	1,173	2,559	11.9	121.2	0.8	6.6
Yellow Irish Lord	767	205	7.8	9.7	0.5	0.5
Sturgeon poacher	32		0.3	0.0	.0	0.0
Smooth lumpsucker	9		0.1	0.0	.0	0.0
Eulachon	1		.0	0.0	.0	0.0
Capelin	3		0.0	0.0	.0	0.0
Herring	71		0.7	0.0	.0	0.0
Giant wrymouth	137		1.4	0.0	0.1	0.0
Starfish spp.		9	0.0	0.4	0.0	.0
Basket starfish	24	3	0.2	0.1	.0	0.0
Snail	6		0.1	0.0	.0	0.0
Corals		7	0.0	0.3	.0	0.0
Jellyfish	369		3.7	0.0	0.2	0.0

-Continued-

Table 9. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the second quarter of 1982, by area and species (continued).

Species	Observed Catch		CPUE		Percent Composition	
	Kodiak	Bering Sea	Kodiak	Bering Sea	Kodiak	Bering Sea
Sea urchin	5		0.1	0.0	.0	0.0
Aea anemonie	22		0.2	0.0	.0	0.0
Sea pen		4	0.0	0.2	.0	0.0
Sponge		15	0.0	0.7	.0	0.0
Fish parts	79		0.8	0.0	0.1	0.0
Hours	98.8	21.1				
Hauls	42	12				

Table 10. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the first quarter of 1984, by area and species.

Species	Observed Catch		CPUE		Percent Composition	
	Bering Sea	Kodiak	Bering Sea	Kodiak	Bering Sea	Kodiak
Tanner crab	6	92	0.1	1.0	.0	0.1
Korean horsehair crab	85	0	0.9	0.0	0.1	0.0
Dungeness crab	0	12	0.0	.1	0.0	.0
King crab	0	23	0.0	0.3	0.0	.0
Sleeper shark	91	0	0.9	0.0	0.1	0.0
Dogfish	2	0	.0	0.0	.0	0.0
Skate spp.	162	638	1.7	7.2	0.1	0.4
Big skate	46	0	0.5	0.0	.0	0.0
Halibut	5,862	3,583	60.6	40.2	4.7	2.1
Flathead sole	1,165	3,733	12.0	41.9	0.9	2.2
Rocksole	465	8,570	4.8	96.2	0.4	5.0
Rex sole	656	1,388	6.8	15.5	0.5	0.8
Alaska plaice	0	395	0.0	4.4	0.0	0.2
Dover sole	0	153	0.0	1.7	0.0	0.1
English sole	0	214	0.0	2.4	0.0	0.1
Butter sole	0	103	0.0	1.2	0.0	0.1
Yellowfin sole	0	142	0.0	1.6	0.0	0.1
Arrowtooth flounder	1,214	8,174	12.5	91.7	1.0	4.8
Starry flounder	0	614	0.0	6.9	0.0	0.4
Pollock	3,843	13,204	39.7	148.1	3.1	7.8
Cod	107,651	124,388	1111.7	1395.5	87.0	73.1
Sablefish	147	263	1.5	2.9	0.1	0.2
Atka mackerel	0	48	0.0	0.5	0.0	.0
Prowfish	0	4	0.0	.0	0.0	.0
King salmon	8	159	0.1	1.8	.0	0.1
Silver salmon	4	0	.0	0.0	.0	0.0
Pacific Ocean perch	5	174	0.1	1.9	.0	0.1
Northern rockfish	0	6	0.0	0.1	0.0	.0
Rougheye rockfish	2	2	.0	0.0	.0	0.0
Yelloweye rockfish	11	46	0.1	0.5	.0	.0
Harlequin rockfish	0	123	0.0	1.4	0.0	0.1
Dusky rockfish	0	32	0.0	0.4	0.0	.0
Shortspine thornyhead	0	51	0.0	0.6	0.0	.0
Sculpin spp.	158	3,378	1.6	37.9	0.1	2.0
Bigmouth sculpin	11	219	0.1	2.4	.0	0.1
Great sculpin	738	0	7.6	0.0	0.6	0.0
Yellow Irish Lord	1,327	0	13.7	0.0	1.1	0.0
Sea poacher spp.	0	0	0.0	0.0	0.0	0.0
Snailfish spp.	0	4	0.0	.0	0.0	.0
Lingcod	0	2	0.0	.0	0.0	.0
Herring	0	0	0.0	0.0	0.0	0.0

-Continued-

Table 10. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the first quarter of 1984, by area and species (continued).

Species	Observed Catch		CPUE		Percent Composition	
	Bering Sea	Kodiak	Bering Sea	Kodiak	Bering Sea	Kodiak
Giant wrymouth	0	25	0.0	0.3	0.0	.0
Starfish	53	0	0.5	0.0	.0	0.0
Basket starfish	4	0	.0	0.0	.0	0.0
Squid	53	0	0.5	0.0	.0	0.0
Sea anemonie	0	50	0.0	0.6	0.0	.0
Octopus	0	53	0.0	0.6	0.0	.0
Sponge	3	0	.0	0.0	.0	0.0
Hours	96.8	89.1				
Hauls	27	54				
Total	123,772	170,062				

Table 11. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the second quarter of 1984 in the Kodiak area, by species.

Species	Observed Catch	CPUE	Percent Composition
King crab	3,058	17.8	1.2
Tanner crab	2,691	15.7	1.1
Dungeness crab	68	0.4	.0
Dogfish	2	.0	.0
Shrimp spp.	13	0.1	.0
Sidestripe shrimp	20	0.1	.0
Coonstripe shrimp	10	0.1	.0
Skate spp.	6,557	38.2	2.6
Halibut	14,024	81.7	5.5
Greenland turbot	73	0.4	.0
Flathead sole	44,215	257.5	17.5
Rocksole	10,496	61.1	4.1
Rex sole	24	0.1	.0
Alaska plaice	936	5.5	0.4
Dover sole	840	4.9	0.3
English sole	341	2.0	0.1
Butter sole	2,407	14.0	1.0
Sandsole	3,053	17.8	1.2
Yellowfin sole	207	1.2	0.1
Arrowtooth flounder	17,420	101.5	6.9
Starry flounder	3,135	18.2	1.2
Pollock	30,496	177.6	12.1
Cod	106,270	618.9	42.0
Sablefish	390	2.3	0.2
Atka mackerel	9	0.1	.0
Prowfish	12	0.1	.0
King salmon	123	0.7	.0
Eelpout spp.	25	0.1	.0
Rockfish spp.	247	1.4	0.1
Northern rockfish	40	0.2	.0
Rougheye rockfish	207	1.2	0.1
Yellowtail rockfish	1	.0	.0
Yelloweye rockfish	1	.0	.0
Redstripe rockfish	5	.0	.0
Dusky rockfish	22	0.1	.0
Greenling spp.	38	0.2	.0
Sculpin spp.	4,210	24.5	1.7
Bigmouth sculpin	450	2.6	0.2
Snailfish spp.	11	0.1	.0
Lingcod	8	.0	.0
Giant wrymouth	228	1.3	0.1
Starfish	7	.0	.0
Basket starfish	124	0.7	.0

-Continued-

Table 11. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the second quarter of 1984 in the Kodiak area, by species (continued).

Species	Observed Catch	CPUE	Percent Composition
Weathervane scallop	1	.0	.0
Snail spp.	3	.0	.0
Sea urchin	178	1.0	0.1
Sea anemonie	23	0.1	.0
Octopus	218	1.3	0.1
Hours	171.7		
Hauls	77		
Total	252,937		

Table 12. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the fourth quarter of 1984, by area and species.

Species	Observed Catch Kodiak	Observed Catch Bering Sea	CPUE Kodiak	CPUE Bering Sea	Percent Composition Kodiak	Percent Composition Bering Sea
Tanner crab	1	0	0.1	0.0	.0	0.0
Dogfish	4	3	0.3	0.2	.0	.0
Salmon shark	920	0	72.6	0.0	1.4	0.0
Coonstripe shrimp	1	0	0.0	0.0	.0	0.0
Rattail spp.	0	14	0.0	1.1	0.0	.0
Skate spp.	1,618	282	127.7	20.9	2.4	0.7
Skate egg case	7	16	0.5	1.2	.0	.0
Deepsea skate	24	0	1.9	0.0	.0	0.0
Big skate	63	0	5.0	0.0	0.1	0.0
Longnose skate	3	0	0.2	0.0	.0	0.0
Halibut	1,194	1,200	94.0	88.8	1.8	2.9
Flathead sole	735	589	58.0	43.7	1.1	1.4
Rocksole	73	3,491	5.7	258.5	0.1	8.3
Rex sole	3	3,561	0.2	263.8	.0	8.5
Alaska plaice	1	0	0.1	0.0	.0	0.0
Dover sole	352	0	27.8	0.0	0.5	0.0
English sole	103	0	8.1	0.0	0.2	0.0
Yellowfin sole	41	0	3.2	0.0	0.1	0.0
Arrowtooth flounder	16,988	4,120	1341.2	305.2	25.4	9.8
Starry flounder	3	0	0.2	0.0	.0	0.0
Pollock	6,667	8,225	526.4	609.2	10.0	19.6
Cod	29,750	14,852	2,348.7	1,100.2	44.4	35.4
Sablefish	2,646	3,238	208.9	239.9	3.9	7.7
Atka mackerel	3	0	0.2	0.0	.0	0.0
Chum salmon	0	3	0.0	0.2	0.0	.0
King salmon	3	3	0.2	0.2	.0	.0
Pacific Ocean Perch	431	390	34.1	28.9	0.6	0.9
Northern rockfish	790	0	62.3	0.0	1.2	0.0
Rougheye rockfish	423	0	33.4	0.0	0.6	0.0
Redbanded rockfish	1	0	0.1	0.0	.0	0.0
Yellowtail rockfish	1,147	0	90.5	0.0	1.7	0.0
Yelloweye rockfish	209	513	16.5	38.0	0.3	1.2
Dusky rockfish	659	8	52.1	0.6	1.0	.0
Shortspine thornyhead	0	1,109	0.0	82.2	0.0	2.6
Greenling spp.	27	0	2.2	0.0	.0	0.0
Sculpin spp.	714	287	56.4	21.3	1.1	0.7
Bigmouth sculpin	1,020	0	80.5	0.0	1.5	0.0
Snailfish spp.	17	6	1.3	0.4	.0	.0
Eulachon	1	0	0.1	0.0	.0	0.0
Capelin	1	0	0.1	0.0	.0	0.0
Giant wrymouth	124	0	9.8	0.0	0.2	0.0

-Continued-

Table 12. Total observed catch, catch composition, and CPUE in kilograms per hour from Alaska Department of Fish and Game groundfish observer trips on domestic trawlers during the fourth quarter of 1984, by area and species (continued).

Species	Observed Catch Kodiak	Observed Catch Bering Sea	CPUE Kodiak	CPUE Bering Sea	Percent Composition Kodiak	Percent Composition Bering Sea
Basket starfish	103	0	8.1	0.0	0.2	0.0
Jellyfish	84	15	6.7	1.1	0.1	.0
Octopus	34	6	2.6	0.4	0.1	.0
Fish parts	1	0	0.1	0.0	.0	0.0
Hours	12.7	13.5				
Hauls	13	6				
Total	66,989	41,931				

Table 13. Total observed catch, catch composition, and CPUE in kilograms per 1000 hooks from Alaska Department of Fish and Game groundfish observer trips on domestic longliners during 1984 in the Kodiak area.

Species	Observed Catch	CPUE	Percent Composition
Golden King crab	26	.1	.0
Sleeper shark	844	4.0	.7
Dogfish	1	.0	.0
Rattail spp.	5,942	27.9	5.2
Aleutian skate	50	.2	.0
Skate spp.	927	4.4	.8
Halibut	1,040	4.9	.9
Dover sole	3	.0	.0
Arrowtooth flounder	4,735	22.3	4.2
Sablefish	92,451	434.8	81.6
King salmon	4	.0	.0
Silver salmon	47	.2	.0
Rougheye rockfish	1,424	6.7	1.3
Yelloweye rockfish	3,754	17.7	3.3
Shortspine thornyhead	1,907	9.0	1.7
Bigmouth sculpin	3	.0	.0
Starfish spp.	1	.0	.0
Basket starfish	4	.0	.0
Snail spp.	27	.1	.0
Coral	2	.0	.0
Sea anemonie	17	.1	.0
Total hooks	212,630		
Total kg	113,225		
Sets	37		

Table 14. Summary of Pacific cod CPUE information obtained with onboard observers, interviews, and fish tickets, by area and time.

Date	CPUE t/hr	Source	Comments
		Kodiak INPFC Area	
1982 Quarter 1	.16	Observer	Apparently targeting on pollock, 17 hauls
1982 Quarter 2	0.36	Observer	42 hauls
1982 April 2*	1.45	Fish Ticket	**
1982 April 9*	.76	Fish Ticket	
1982 April 16*	.46	Fish Ticket	
1982 April 23*	.68	Fish Ticket	
1982 April 30*	.98	Fish Ticket	
1982 May 7*	.83	Fish Ticket	
1982 May 14*	.90	Fish Ticket	
1982 May 21*	1.11	Fish Ticket	
1982 May 28*	.62	Fish Ticket	
1982 June 4*	.77	Fish Ticket	
1982 June 11*	.55	Fish Ticket	
1982 June 18*	.73	Fish Ticket	
1982 June 25*	.67	Fish Ticket	
1982 Nov 5*	.95	Fish Ticket	
1982 Nov 12*	.80	Fish Ticket	
1982 Nov 19*	.92	Fish Ticket	
1982 Nov 26*	.81	Fish Ticket	
1982 Dec 3*	.87	Fish Ticket	
1982 Dec 10*	.69	Fish Ticket	
1982 Dec 17*	.73	Fish Ticket	
1984 Quarter 1	1.39	Observer	54 hauls
1984 Quarter 2	.62	Observer	77 hauls
1984 December	2.34	Observer	13 hauls
		Southern Bering Sea INPFC Area	
1982 March	2.65	Observer	9 hauls
1982 April	1.48	Observer	12 hauls
1982 March	2.25	Interview	1% of landings
1982 April	2.00	Interview	3% of landings
1982 May	.26	Interview	3% of landings
1982 June	.49	Interview	22% of landings
1982 July	.95	Interview	20% of landings
1982 August	.82	Interview	45% of landings
1982 September	.85	Interview	61% of landings
1982 October	.84	Interview	26% of landings

-Continued-

Table 14. Summary of Pacific cod CPUE information obtained with onboard observers, interviews, and fish tickets, by area and time (continued).

Date	CPUE t/hr	Source	Comments
	Southern Bering Sea INPFC Area		
1982 November	.97	Interview	40% of landings
1982 December	.75	Interview	32% of landings
1984 Quarter 1	1.11	Observer	27 hauls
1984 Quarter 4	1.10	Observer	6 hauls

* Week ending date.
** Effort was recorded on the fish ticket.

here. Note that accuracy and precision are not the same; precision is the ability to get the same results repeatedly while accuracy is a measure of the correctness of the answer.

Sablefish Ages:

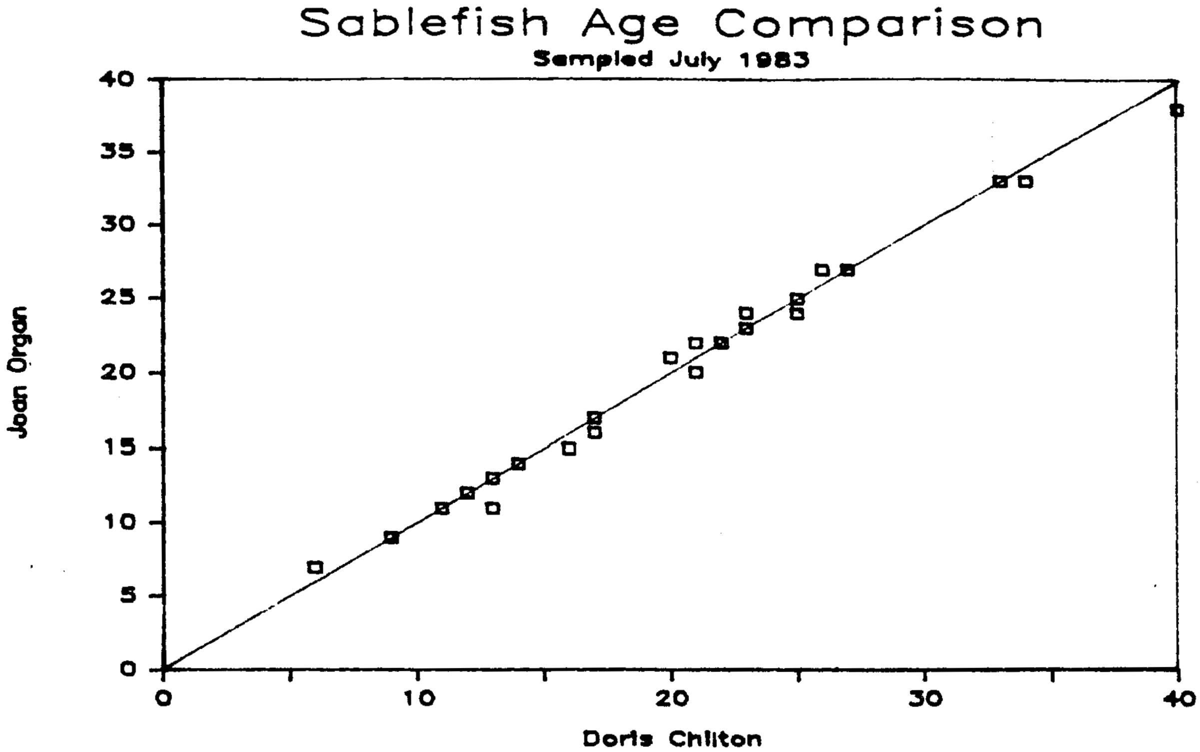
Sablefish were aged by the break and burn technique, which has been preliminarily validated for fish in Canadian waters (Beamish and Chilton 1982).

Two samples of sablefish otoliths were aged by both the ADF&G age reader and the aging unit leader at the Pacific Biological Station, Canadian Department of Fisheries and Oceans (Figure 3).

One sample, collected 12 September 1984, contained 38 fish ranging in age from three to 36 years, with all but one fish age 13 or less (Figure 3). There was complete agreement on 54%, differences of one year or less on 84%, differences of 2 years or less on 92%, and all were within 4 years of agreement (Figure 3). The other sample, collected July 1983, contained 29 fish ranging in age from six to 40 years (Figure 3). There was complete agreement on 59%, a difference of one year or less on 93%, and all were within two years of agreement. In addition, two samples totaling 95 fish were aged twice by the ADF&G reader (Figure 4). When this was done, we found that the second reading was less reliable because the burned surface lost contrast within the few days between readings. This test yielded 47% agreement, 80% within one year, 88% within two years, 94% within 3 years, and all were within seven years of agreement. Differences do not appear to increase with age.

A trawl survey conducted annually in Shelikof Strait by the Alaska Department of Fish and Game has yielded size frequencies which clearly show that in 1985 there were three age classes of sablefish present, ages one, two, and four. These ages were deduced from size frequencies of young fish because they grew so rapidly during their first few years of life that there was little overlap in size frequencies and there was fluctuation in abundance of successive age classes which made it possible to graphically follow the progression of modes of fish abundance for successive years. Because of slower growth at greater ages, the separation of modes deteriorates at greater age and size. Ages determined from otoliths collected on these surveys correspond well with the age composition which was deduced from successive annual size frequencies.

The most prominent feature of the sablefish age reading results from the commercial fishery is the addition of a large number of fish in the three to eight year old range in 1984 (Table 15). Several factors may have contributed to this difference between years. In 1983 the foreign fleets were competing on the grounds with the domestic fleet and domestic fishermen reported that they had to fish extremely deep to avoid the heavier foreign gear. Also in 1983, there was virtually no market for small sablefish. In 1984 small sablefish were commonly purchased or used for bait, and foreign fleets were not present. The 1983 information is based on two samples from one vessel while the longline samples from 1984 are based on nine deliveries. Younger fish may have occurred in other deliveries in 1983, but there were few deliveries that year.



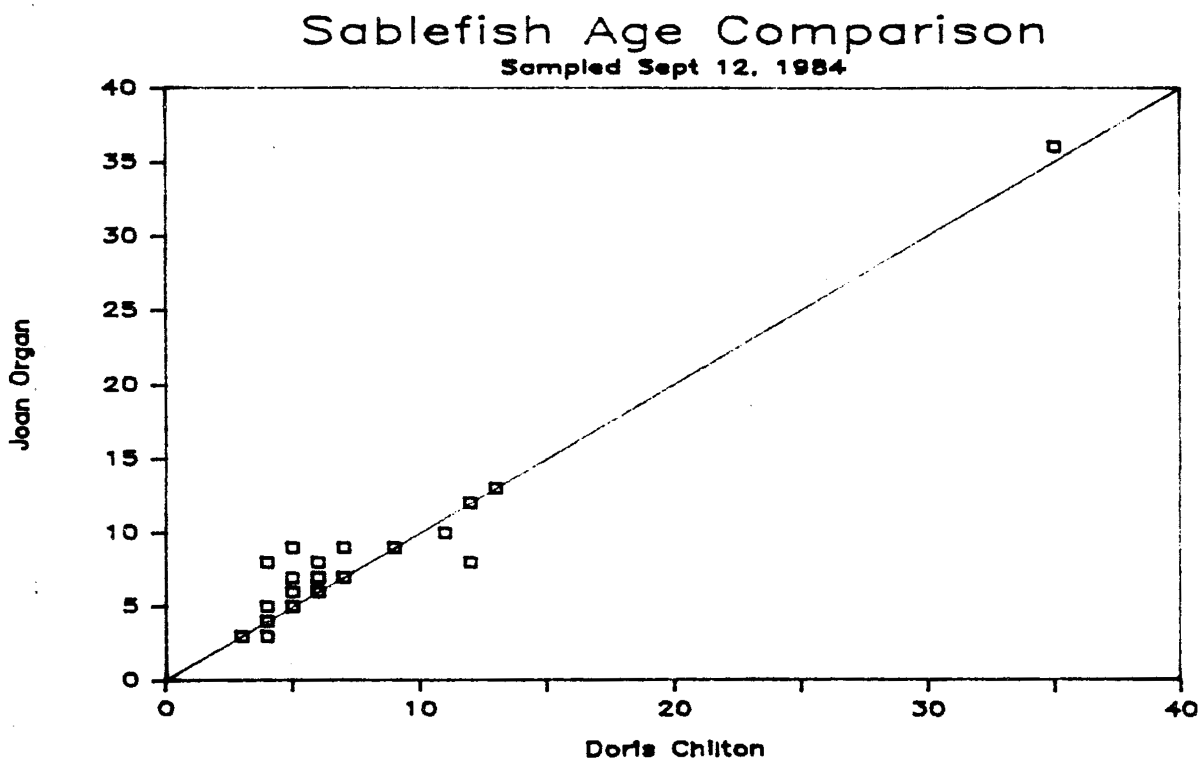


Figure 3. Comparison of ages of sablefish from the Central Gulf of Alaska determined by two different age readers, which is considered a measure of reliability.

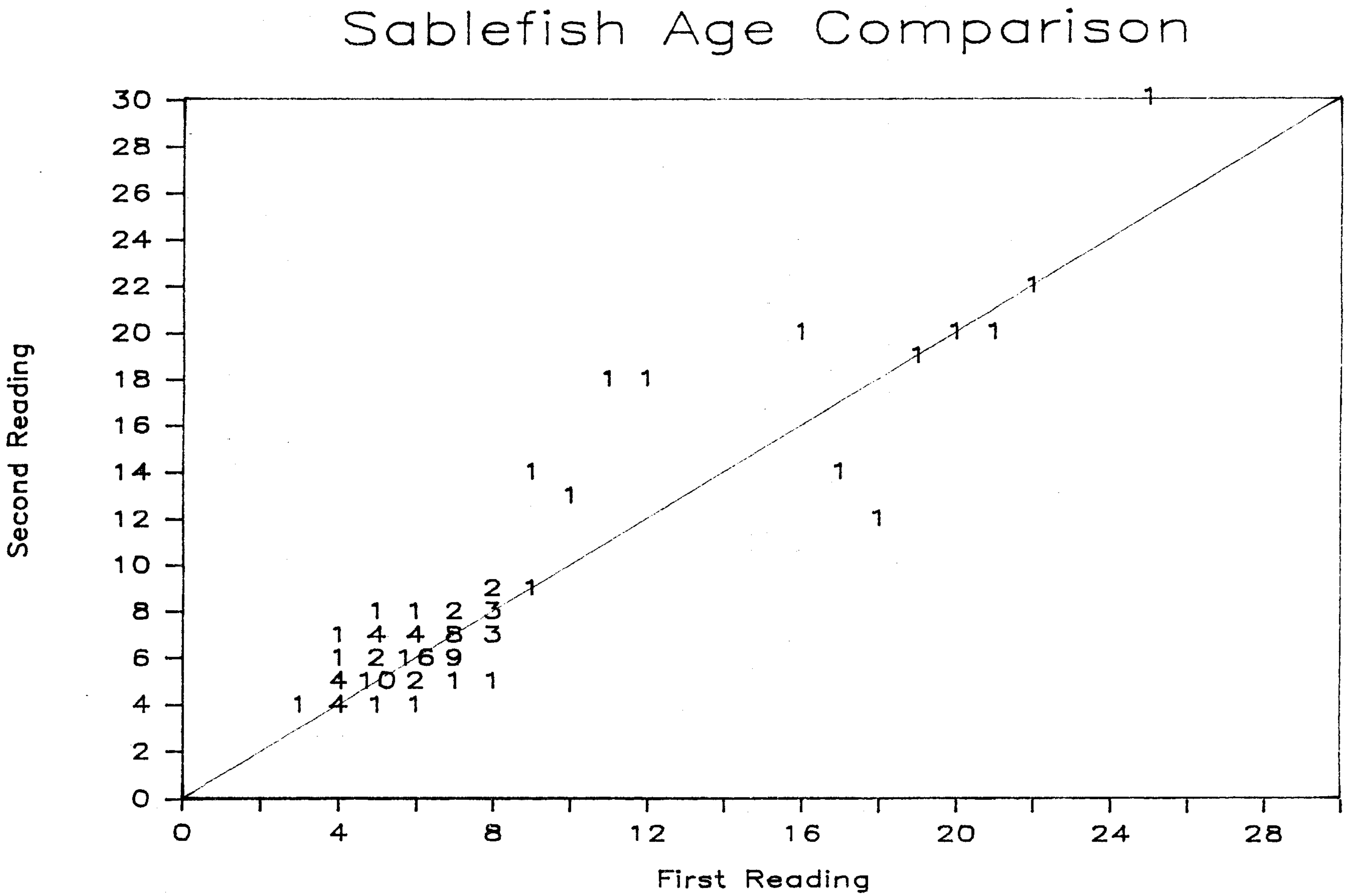


Figure 4. Comparison of successive age determinations of sablefish from the Central Gulf of Alaska. The numbers represent the number of observations at each point.

Table 15. Age composition of sablefish sampled during 1983 and 1984 from the commercial fishery in the Central Gulf of Alaska. Ages were obtained using the break-and-burn methods.

Age	1983 Longline Total	1984 Longline Total	Pots	Trawl	Longline Discard
2					1
3		14	2	1	12
4		26	5	6	18
5	1	52	8	7	5
6	3	111	21	11	6
7	3	139	31	13	3
8	1	29	13	3	
9	3	5	6	3	
10	5	5	3	1	
11	4	4			
12	3	7		2	
13	1	5	2		
14	4	1		1	
15	3	6	1		
16	3	5	1		
17	7	3			
18	2	2		1	
19		4			
20	4				
21	7	1			
22	5	3			
23	6	2			
24	3	1			
25	2	4			
26	3	1			
27	3				
28	1				
29	3	1			
30					
31					
32	3				
33					
34	3		1		
35	2		1		
38		1			
41	1				
42	1	1			
43	1				
44		1			
68	1				
Total	92	434	95	49	45

The age distribution sample from longline discard was obtained on an observer trip by sampling fish which would normally have been discarded (Table 15). These fish ranged in age from two to seven and indicate that the shape of the younger end of the age distribution from the fishery is highly dependent upon sorting of catch which occurs on the fishing grounds. It also indicates that recruitment to the fishery is not complete until at least age 7.

A second important feature of the 1983 and 1984 age distributions is the basic similarity at ages greater than nine (Table 15). The 1964 cohort, age 20 in 1984, is completely missing and the 1970 cohort is small for both years. The maximum ages are similar in each year, but the 1984 age distribution has many more young sablefish and fewer old ones. In 1984 there was an obviously higher proportion of sablefish younger than 10, and the relative abundance of fish aged 10 to 19 years was greater in 1984, as can be seen by the following explanation. If the cohorts are grouped by age for ages 10-18 and 19 and older in 1983 and then compared to the ages 11-19 and 20 and older in 1984, the ratio of middle aged to older fish changed from 0.65 in 1983 to 2.3 in 1984. Fishermen said during interviews that they were fishing much deeper in 1983 than in 1984, and other information suggests that sablefish move deeper as they grow older. The shift of the age distribution was likely caused by the deeper fishing activity in 1983.

Pacific Cod Ages:

There is no validated method for age determination of Pacific cod. Aging was begun in an attempt to develop a workable method. Aging of Pacific cod was accomplished by the break and burn technique. Scales were tried but were judged to be more time consuming to collect, more difficult to interpret, and did not show as many age marks as were present on otoliths of larger fish. Blackburn (1984) presented an analysis of Pacific cod growth based on size frequencies, which agrees with the size at age from fish aged using this technique. Indications of aging error, such as multiple size modes within age classes, or gradual shifts in the assessed abundance of cohorts in successive years, have not been apparent in the data.

Age determination of Pacific cod otoliths from 1984 has not been completed because higher priorities were placed on sablefish and on yelloweye rockfish from the developing fishery in Southeastern Alaska.

Age data from the Kodiak area (Table 16), shows that ages three through six constitute the bulk of the catches in all years. The largest percent contribution by each year class was generally at age four or five, suggesting that recruitment is largely completed by age five. The size preferences of markets vary, but the most restrictive markets preferred fish above a minimum of 57 to 60 cm, which is larger than nearly all age three, about the average size of age four, and is below the majority of age five cod. Thus recruitment of cod begins at age three and is nearly complete at age five, depending on market.

The age data from cod in the Bering Sea, presented in Table 17, shows the progression of the large 1977 class through the fishery much more clearly than in the Kodiak area. The 1977 cohort is more prominent in the Bering Sea than is the same cohort in the Kodiak area. In the Bering Sea it is also

Table 16. Age composition in percentage by number of Pacific cod from port sample collections in the Kodiak area in 1981 through 1984, by quarter year. Ages were obtained using the break-and-burn method and, beginning in 1983, length frequencies were expanded from an age-length key constructed for each quarter.

	Age												#	#
Date	Unk	1	2	3	4	5	6	7	8	9	10	11	Aged	Meas
1981														
Q1			5	12	35	20	20	6	3				102	NA
Q2				2	11	32	17	17	9	11	2		47	NA
Q3			7	8	46	9	12	9	9	2			104	NA
1982														
Q1			12	31	31	16	9						74	NA
Q2			1	16	38	37	4	3	0	0			250	NA
Q4		2	24	29	7	29	5	3	2	1			119	NA
1983														
Q1	11		2	24	31	14	15	2	1	0	0		242	1855
Q2	1			5	23	16	42	7	4	3	0		427	3427
Q4	0		2	31	27	14	21	3	2	0			437	7665
1984														
Q2			0	14	40	18	13	13	2	0	0	0	366	2005

Table 17. Age composition in percentage by number of Pacific cod from port sample collections in the Bering Sea in 1981 through 1984, by quarter year. Ages were obtained using the break-and-burn method and, beginning in 1983, length frequencies were expanded from an age-length key constructed for each quarter.

	Age												#	#
Date	Unk	2	3	4	5	6	7	8	9	10	11	12	Aged	Meas
1981														
Q1			1	36	38	14	8	2	2				115	NA
1982														
Q1		2	12	5	69	7	2	2	2				58	NA
Q4		2	11	12	67	6	1	0	1				470	NA
Seguam Pass														
Q1			3	16	30	10	15	17	3	3	2	1	115	NA
1983														
Q1	1	0	1	9	21	60	7	1					449	6938
Q2*	0	0	24	28	24	23	1						451	812
Q2*	2	1	16	20	24	37	1						451	3211
1984														
Q1		1	9	8	13	18	42	4	4				271	NA

* Two samples during the second quarter of 1983 used a common age-length key. The upper sample was taken at port and the lower was taken by an observer on a floating processor.

clear that recruitment is not complete until age five, since the 1976 cohort predominated the catch in 1981. The 1977 cohort predominated the catches beginning in 1982 and has been prominent through 1984. In 1982 an observer was lucky enough to accompany a vessel to Seguam Pass where an age sample was obtained. These fish proved to have a very different age distribution (Table 17) suggesting that they are a separate population. The 1977 cohort, age five in 1982, was only slightly predominant, not greatly so as in other areas of the Bering Sea; and the older age classes were present in much greater proportions than in other areas (Table 17).

Pacific Ocean Perch Ages:

Pacific ocean perch were all aged by the break and burn technique, which has been used successfully by Canadian researchers (Beamish 1979). This technique has been recommended by the Committee of Age Reading Experts (CARE) sponsored by the Pacific Marine Fisheries Commission, which rated Pacific ocean perch as the most difficult species to age among those rated (Pacific Coast Groundfish Aging Technicians 1984). The ages presented from samples taken in 1982 are probably one year too high because the kernel or central core of the otoliths was counted. This practice was later learned to be inappropriate.

The age distributions of Pacific ocean perch show a considerable range in ages, from four to 69 (Table 18). They also show a marked uneveness. Large cohorts seem to have been produced in 1976 and about 1940 in the Gulf of Alaska and 1968, perhaps 1961, and about 1950-54 in the Bering Sea. In the Kodiak area several samples of incidentally caught perch were uniformly old fish; and two samples from a target fishery for perch were uniformly young, which indicates that target and incidental fisheries utilize different segments of the population.

Black and Dusky Rockfish Ages:

As with Pacific ocean perch, black rockfish *(Sebastes melanops)* and dusky rockfish *(Sebastes ciliatus)* were aged by breaking and burning the otoliths. Black rockfish were rated by CARE as the easiest species to age with this technique. Although CARE has not worked with dusky rockfish otoliths, our experience has been that they are about the same level of difficulty as black rockfish otoliths. For both these species the annuli have been clear and easily identifiable. From previous work with black rockfish, prominent cohorts and missing cohorts have advanced in age along with the calendar, suggesting that the results are reliable.

The prominent 1975 and 1976 cohorts of black rockfish, ages eight and nine in the 1984 sample, have been prominent in other samples collected since 1978 as has the 1972 cohort. Since recruitment of black rockfish was not complete until they were about age 14 based on other commercial samples examined, the prominence of the 1975 and 1976 cohorts suggests that these cohorts are unusually large for this species.

Dusky rockfish have not been aged by other agencies, and the age presented here are the first reported by this office. They are long lived, attaining

Table 18. Number of rockfish at age by species and year of sample for samples collected during 1982-1984 in the Westward Region. Ages were obtained using the break-and-burn method.

Age	Pacific Ocean Perch			Kodiak		
	1982	1984		Black Rockfish		Dusky Rockfish
	Kodiak	Kodiak	Bering Sea	1983	1984	1984
4	1					
5					3	
6	38					
7	5	2		2		1
8	4	1		3	24	2
9	7			4	29	1
10	3				2	2
11	7				2	5
12	8			2	4	1
13	6				1	
14						4
15			3			1
16			7		3	
17			1		4	4
18	1					
16			7		3	
17			1		4	4
18			1	1	2	
19	1		1		4	1
20			1		1	3
21			1	2	4	2
22			1		2	4
23			3	4	4	
24					1	2
25			1	1	1	
26			1		3	2
27					2	4
28					1	2
29		1				
30			1			
31			2			
32		3	3			
33			2			
34			2		1	
35		1				
36		1	1			
37	1	4				
38		3				
39						1
40		1				
41	1	3				
42	1	2				

-Continued-

Table 18. Number of rockfish at age by species and year of sample for samples collected during 1982-1984 in the Westward Region. Ages were obtained using the break-and-burn method (continued).

Age	Pacific Ocean Perch 1982 Kodiak	Pacific Ocean Perch 1984 Kodiak	Pacific Ocean Perch 1984 Bering Sea	Kodiak Black Rockfish 1983	Kodiak Black Rockfish 1984	Kodiak Dusky Rockfish 1984
43		8				
44	1	17				1
45		9				
46	1	2				
47	1	3				
48		3				
49		3				
50						
51	1	1				
52		4				
53		4				
54		2				
55		2				
56		1				
57		1				
58		1				
59		2				
60		1				
61		1	1			
62		1				
63		1				
64		1				
65						
66						
67						
68						
69		1				
Total	87	91	33	19	98	43

* 1982 ages are probably one year too high due to counting of the "kernel" of the otoliths, which was later found to be inappropriate.

age 44, and have no great variation in abundance between cohorts. The dusky rockfish represent what appears to be two different species, one of which is undescribed[1].

Size Distribution

The size distributions of cod in the Kodiak area from 1982 through 1984 indicate the relative consistency of abundance of the cohorts present in the fishery (Figure 5). There are no prominent features of seasonality or progressive change. The numbers of cod less than 55 to 60 cm fluctuate considerably but this is a result of variation in onboard sorting and discard. The absence of data from the third quarter of each year is a reflection of the seasonal low in groundfish fishing activity.

Size distributions of cod from the Bering Sea also reflect very little change (Figure 6). The one size distribution sample from the second quarter of 1983 contains smaller fish and a second mode at a smaller size than is present in the other quarterly figures. This sample was obtained at sea aboard a floating processor in the vicinity of Port Moller in late May, while the other samples were from the fishery in the Unimak Pass area.

Pollock in the Kodiak area consistently had modal sizes in the 40 to 45 cm size range, with almost all the fish within 35 to 50 cm (Figure 7).

The directed fishery on Pacific ocean perch in the Kodiak area during May and June 1982 captured much smaller fish than were seen in incidental catches taken in 1984 (Figure 8). The sample of perch from the Bering Sea in 1984 reflects a comparatively broad size distribution.

The fisheries for flounder require fish of about one pound minimum size in order to obtain fillets that are at least two ounces each. This translates to a minimum usable length of about 30 cm. The size distributions of flathead sole *(Hippoglossoides elassodon)* and rock sole *(Lepidopsetta bilineata)* reflect the discard of fish smaller than the minimum usable size, while the shape of the size distribution above the minimum size more accurately portrays the size distribution of the catch (Figure 9).

DISCUSSION

Sablefish Fishery

The domestic sablefish catch in the Central and Western Gulf and the Bering Sea/Aleutians areas (Figure 1) was minimal through 1982. There were occasional targeted deliveries by trawl vessels, but most of the catch was

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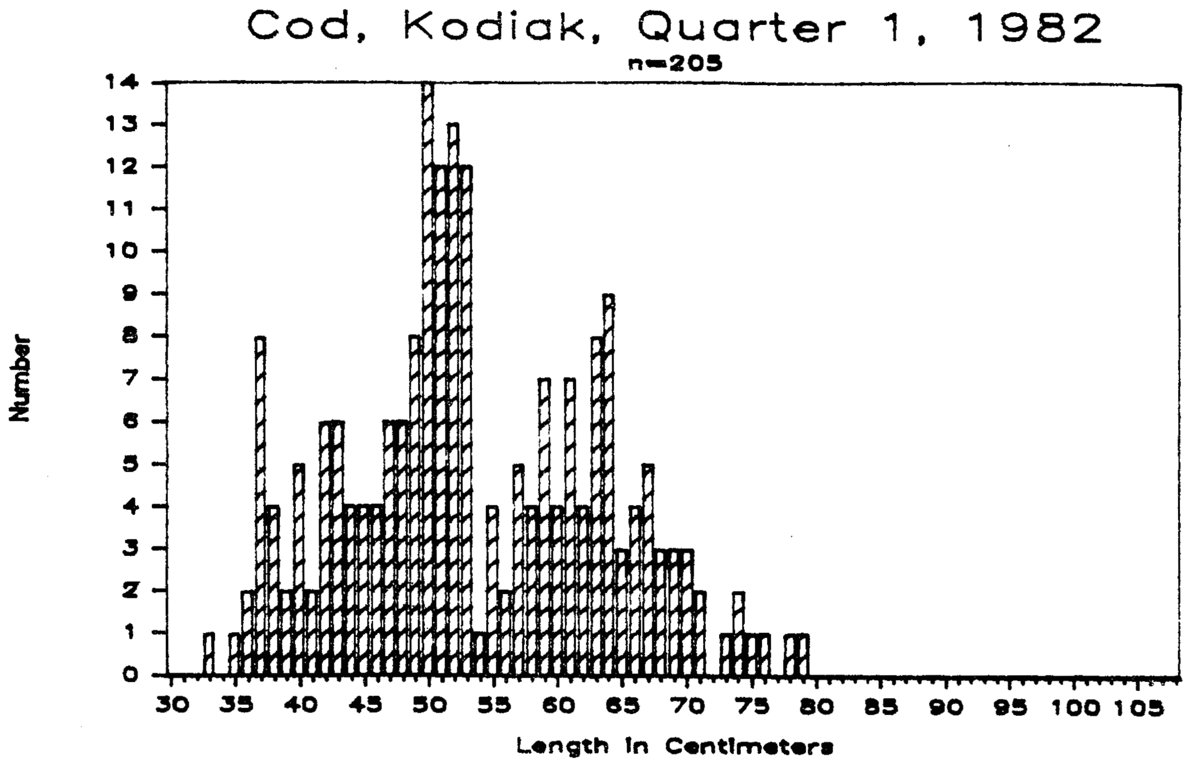
1 A number of the two types of dusky rockfish have been collected by the author. Meristic counts and morphometric measurements have been taken and there is clearly a difference between the two types. Age data reflects differences in age structure of the populations, differences in growth rates, and in ultimate size. Some electrophoretic work has also confirmed the difference. Work on this taxonomic problem is continuing slowly.



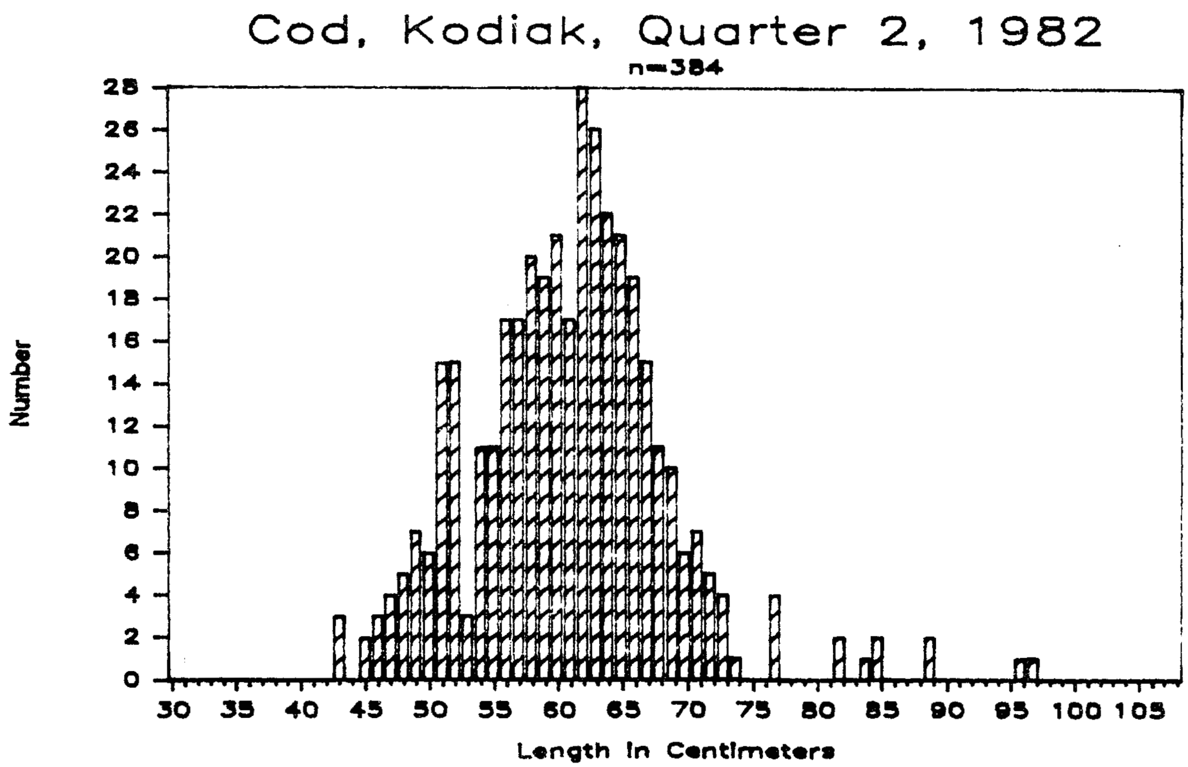
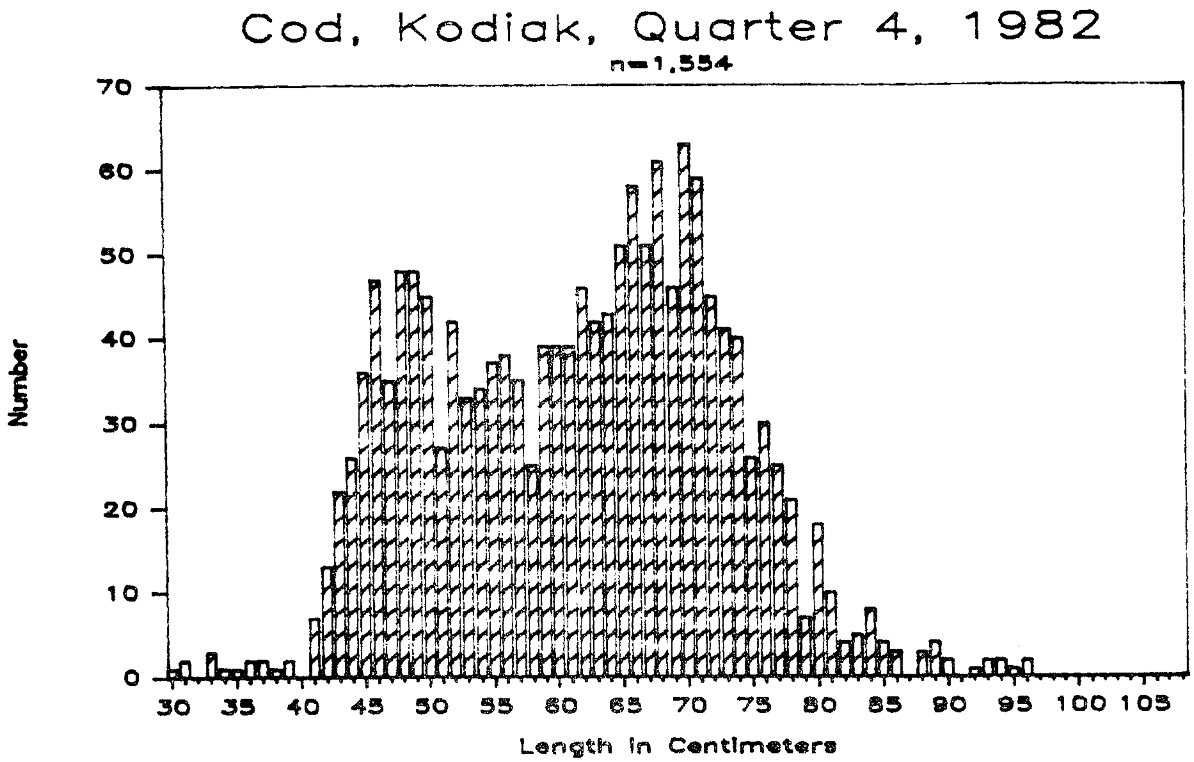


Figure 5. Numbers of Pacific cod *(Gadus macrocephalus)* by size collected from the commercial fishery in the Kodiak area by port samplers and observers during 1982 through 1984.



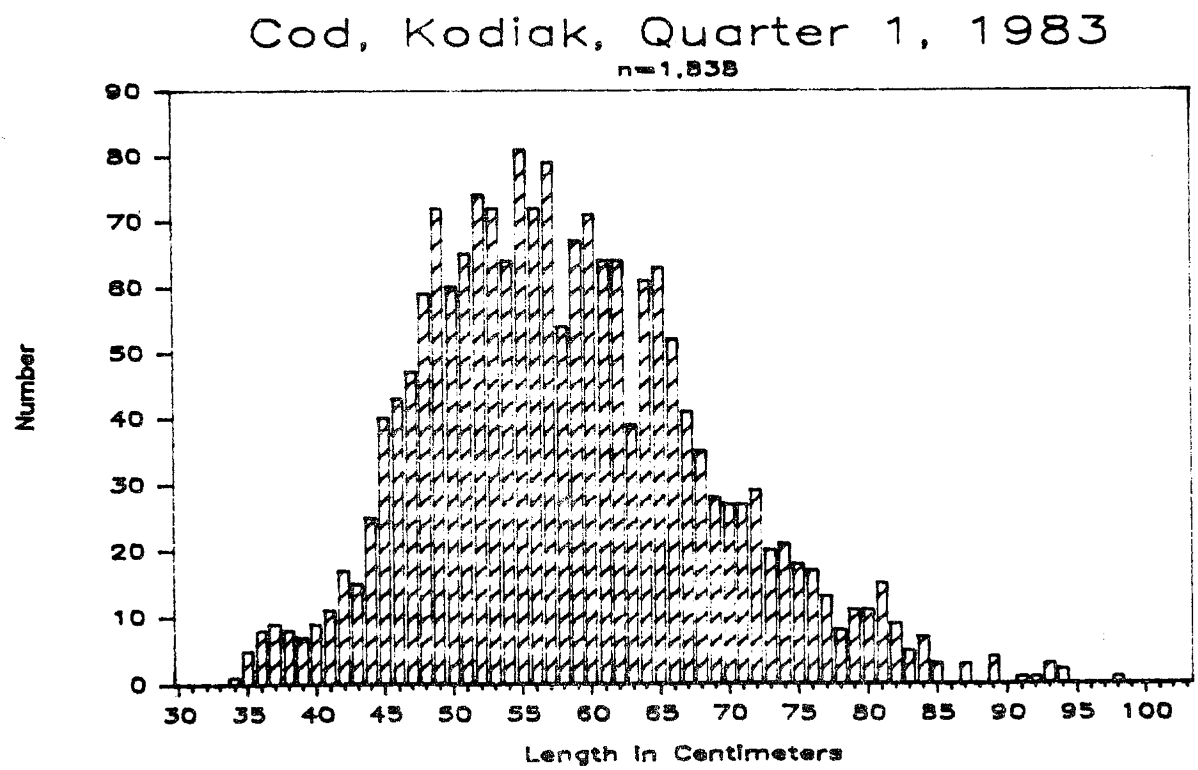
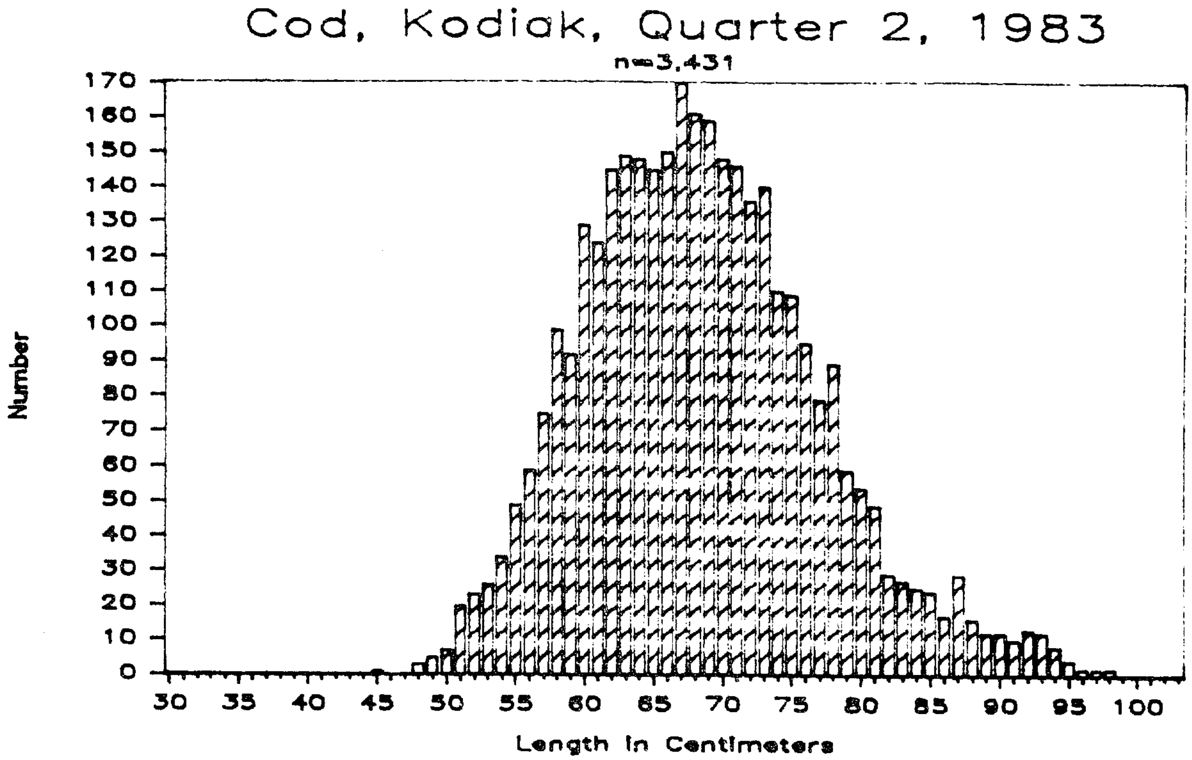


Figure 5. Numbers of Pacific cod *(Gadus macrocephalus)* by size collected from the commercial fishery in the Kodiak area by port samplers and observers during 1982 through 1984 (continued).



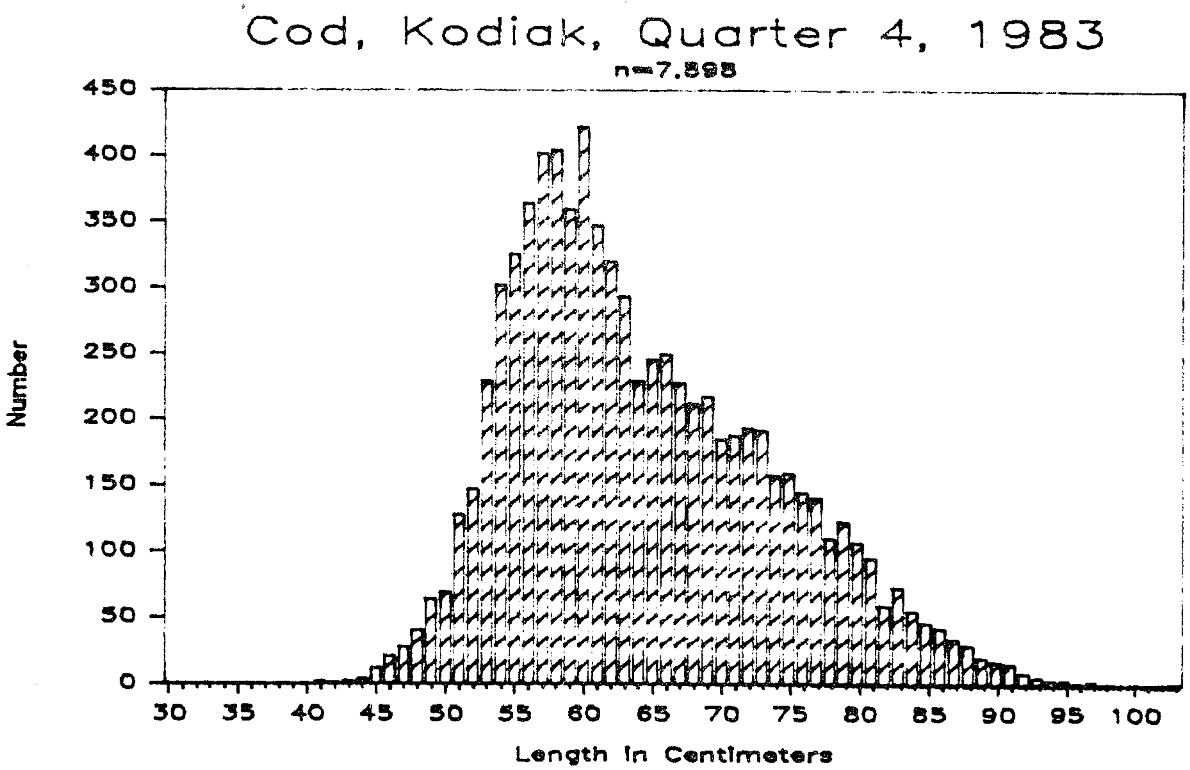
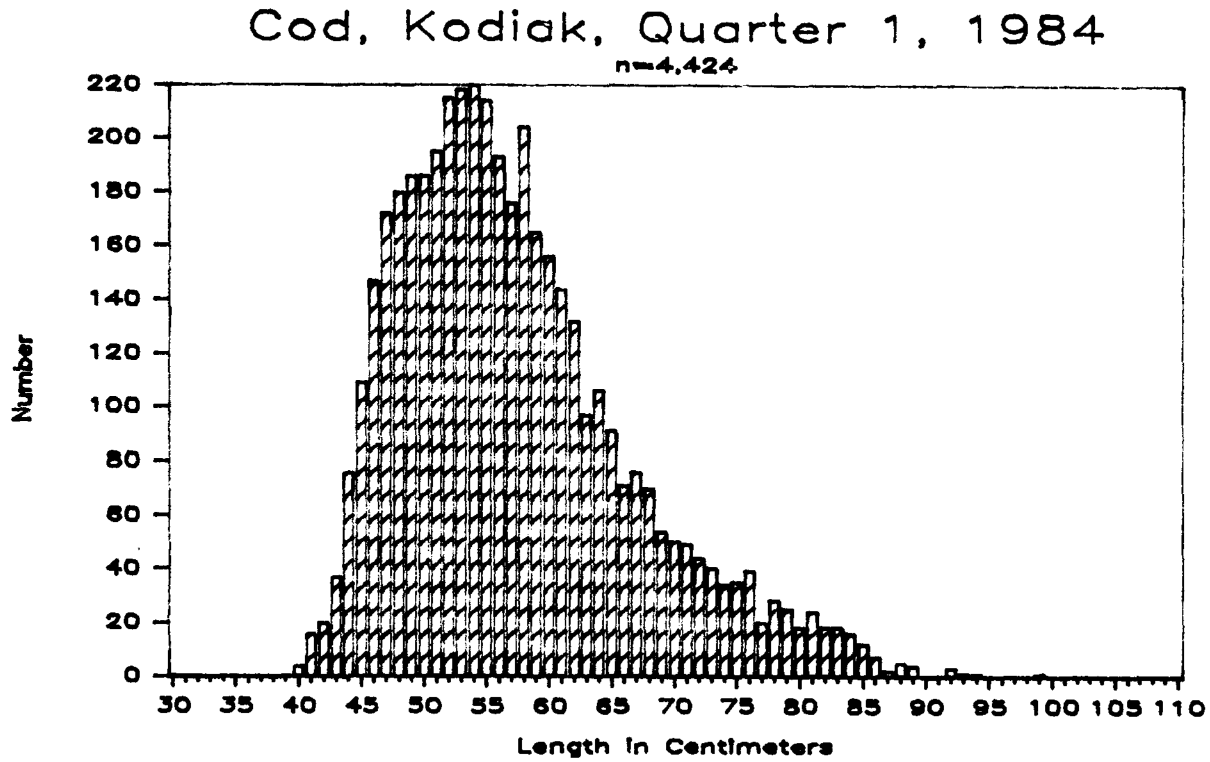


Figure 5. Numbers of Pacific cod *(Gadus macrocephalus)* by size collected from the commercial fishery in the Kodiak area by port samplers and observers during 1982 through 1984 (continued).



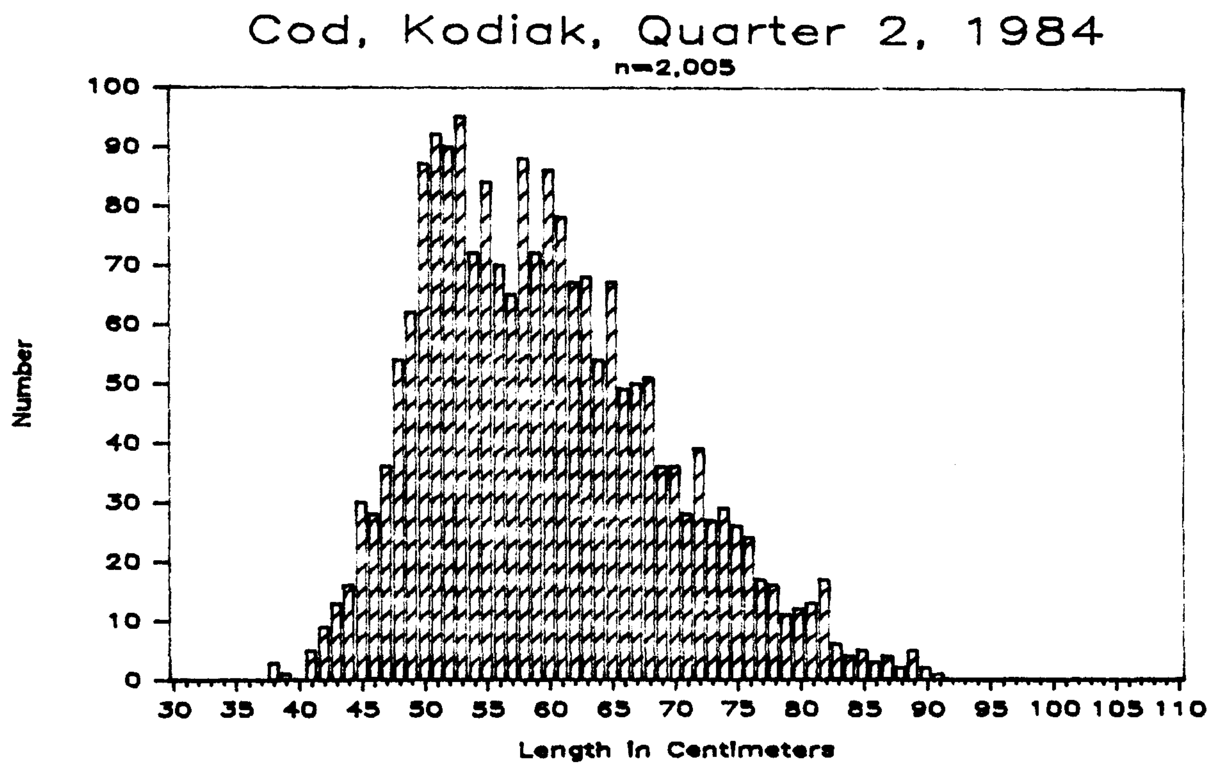


Figure 5. Numbers of Pacific cod *(Gadus macrocephalus)* by size collected from the commercial fishery in the Kodiak area by port samplers and observers during 1982 through 1984 (continued).

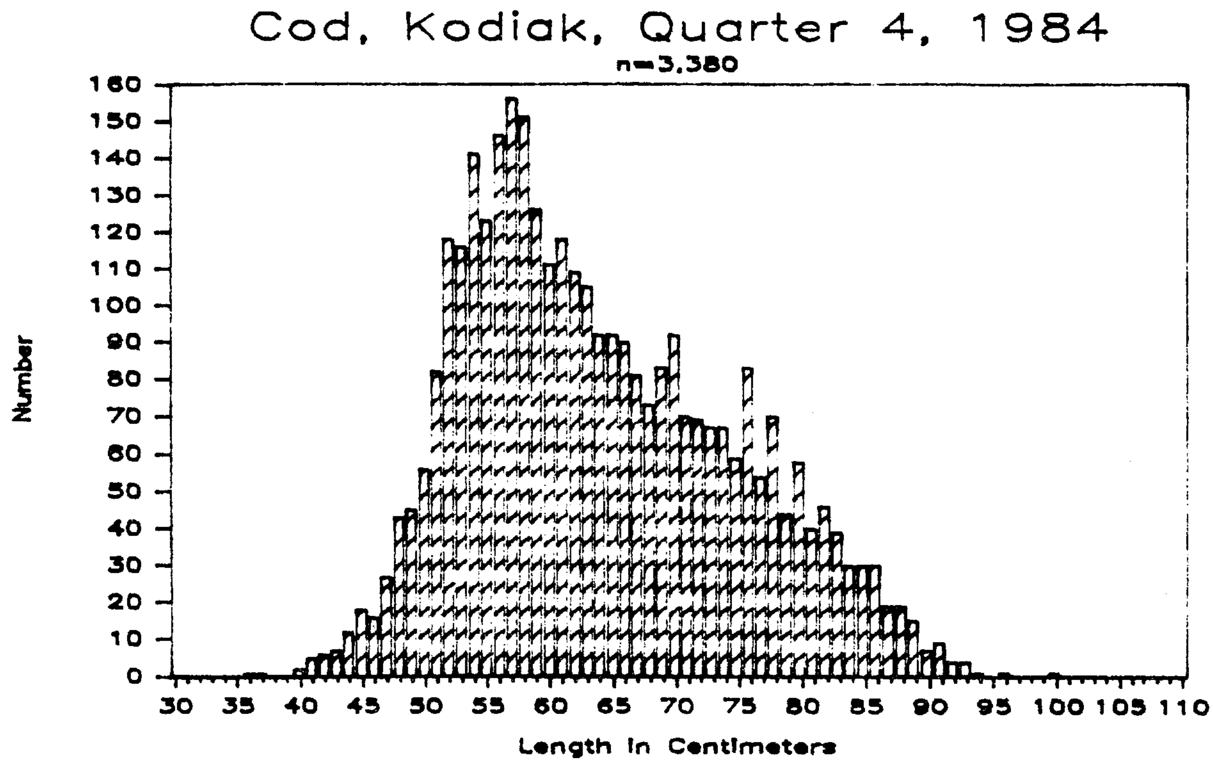


Figure 5. Numbers of Pacific cod *(Gadus macrocephalus)* by size collected from the commercial fishery in the Kodiak area by port samplers and observers during 1982 through 1984 (continued).

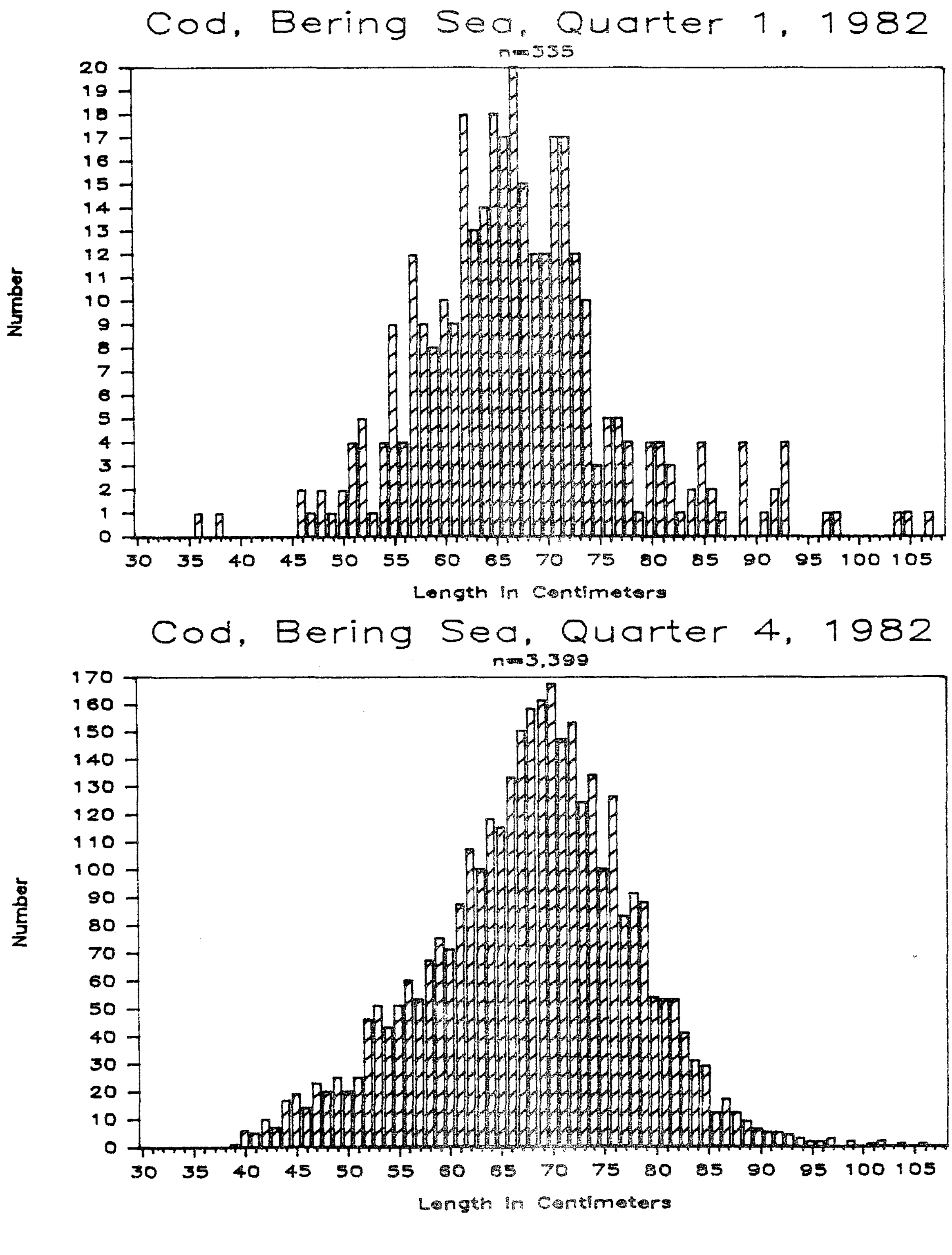
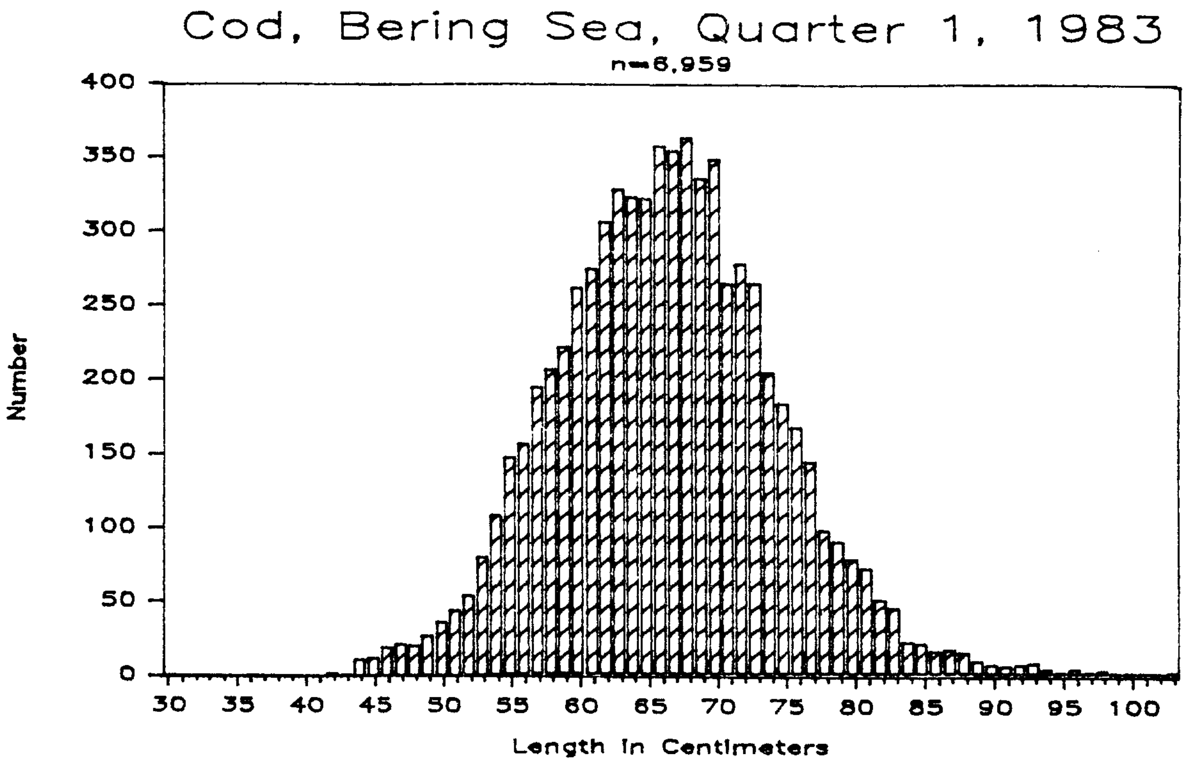


Figure 6. Numbers of Pacific cod *(Gadus macrocephalus)* by size collected from the commercial fishery in the Bering Sea area by port samplers and observers during 1982 through 1984.



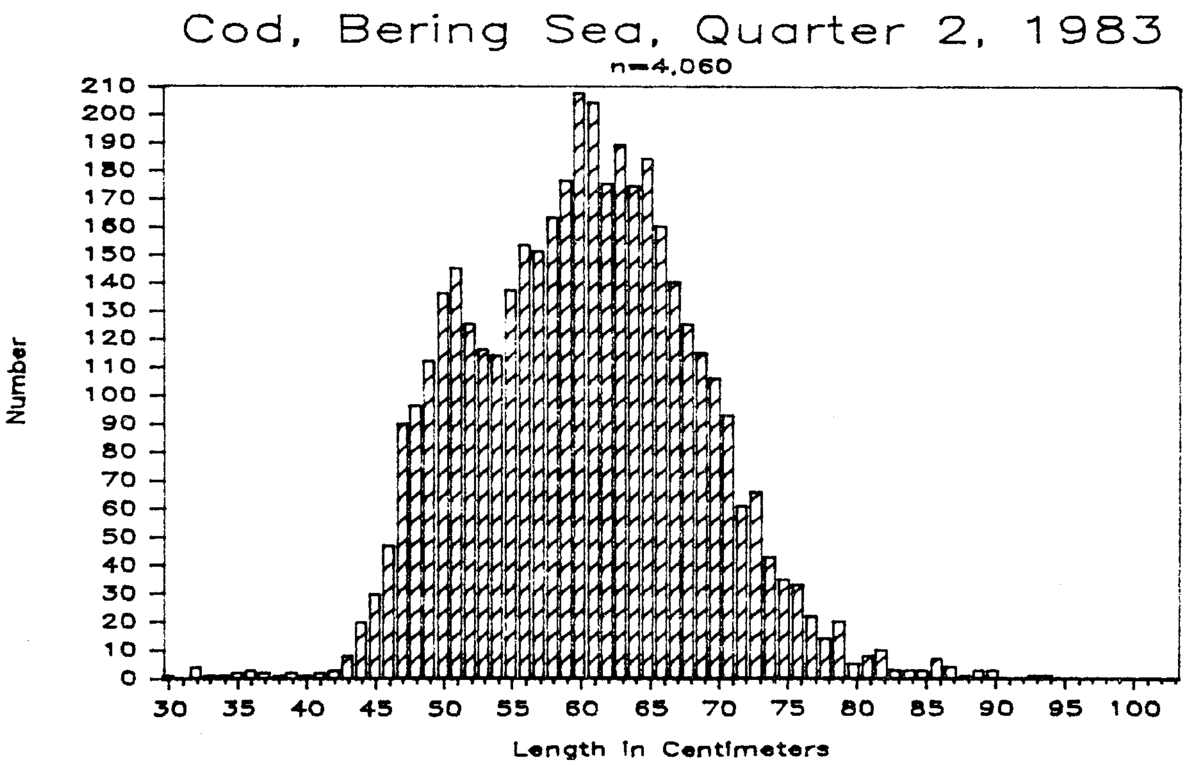
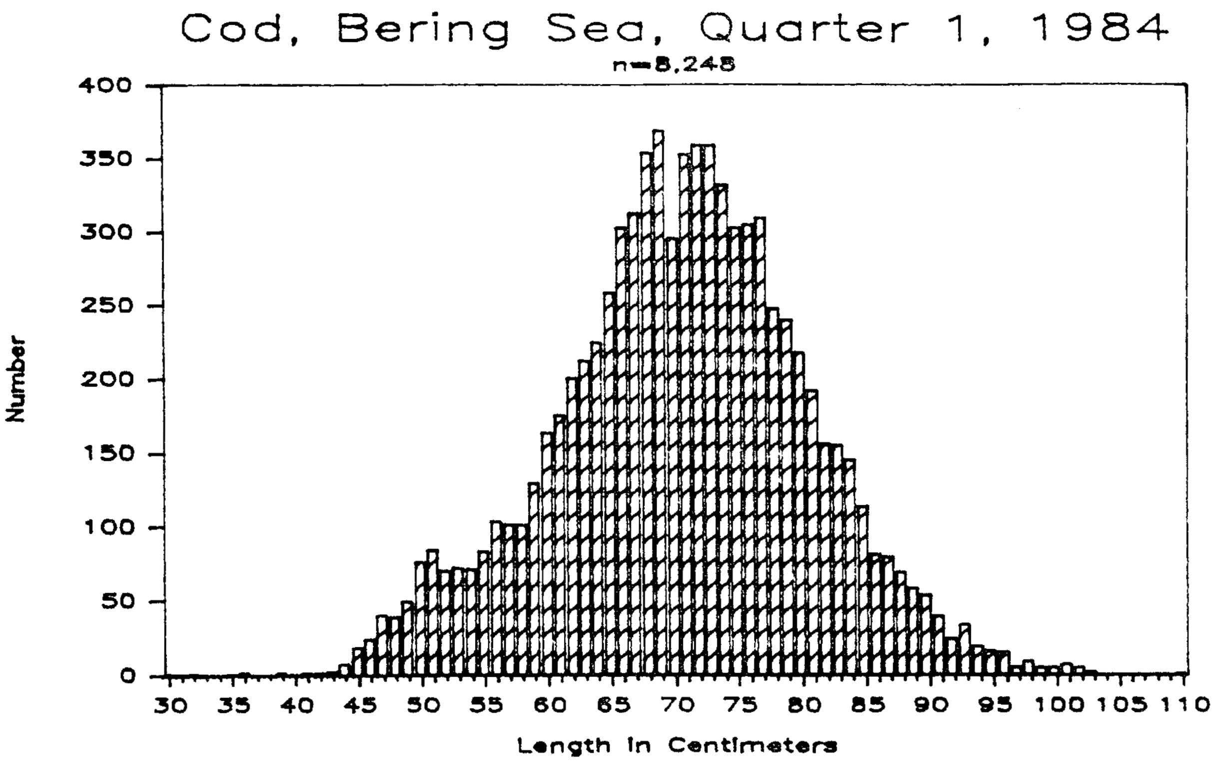


Figure 6. Numbers of Pacific cod *(Gadus macrocephalus)* by size collected from the commercial fishery in the Bering Sea area by port samplers and observers during 1982 through 1984 (continued).



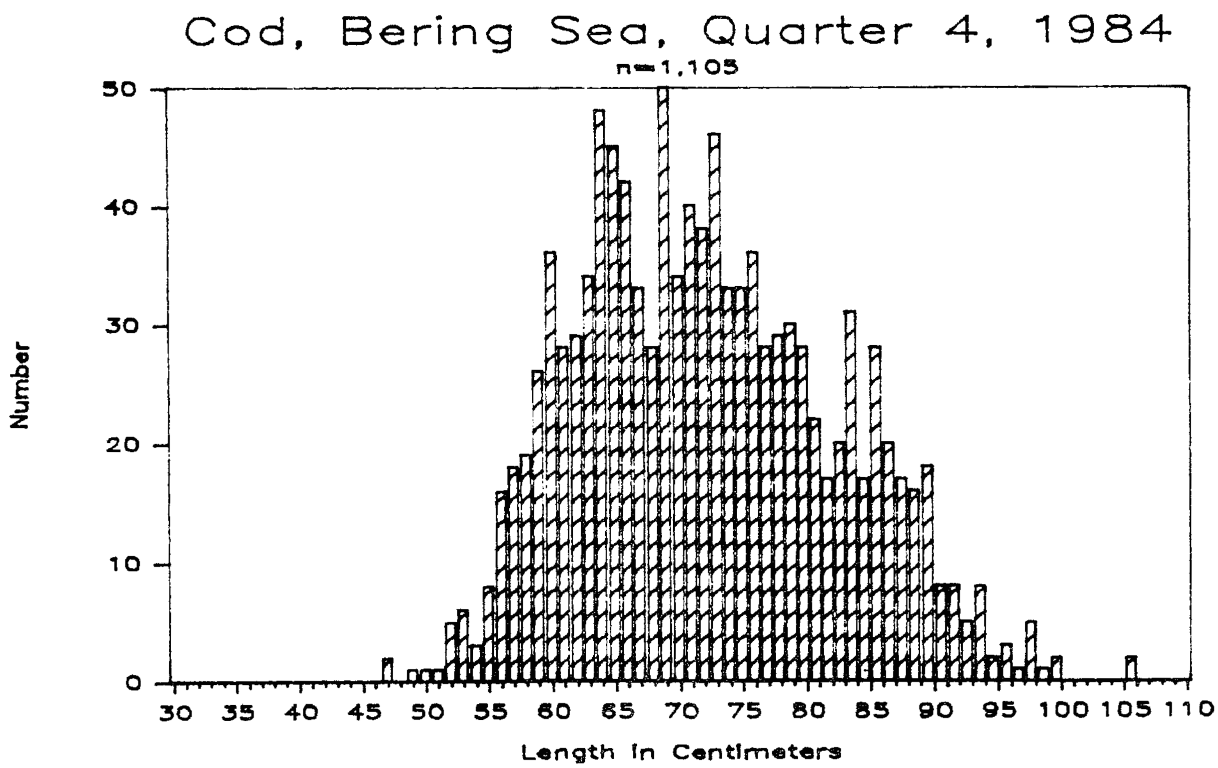
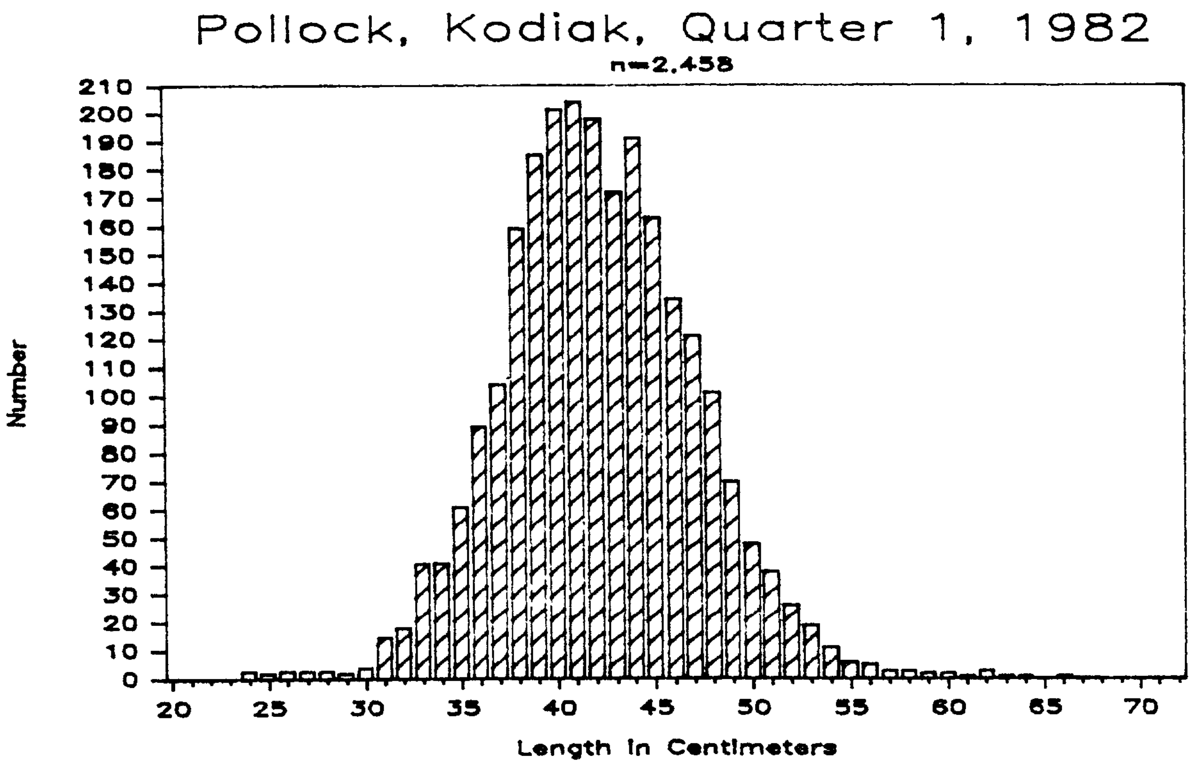


Figure 6. Numbers of Pacific cod *(Gadus macrocephalus)* by size collected from the commercial fishery in the Bering Sea area by port samplers and observers during 1982 through 1984 (continued).



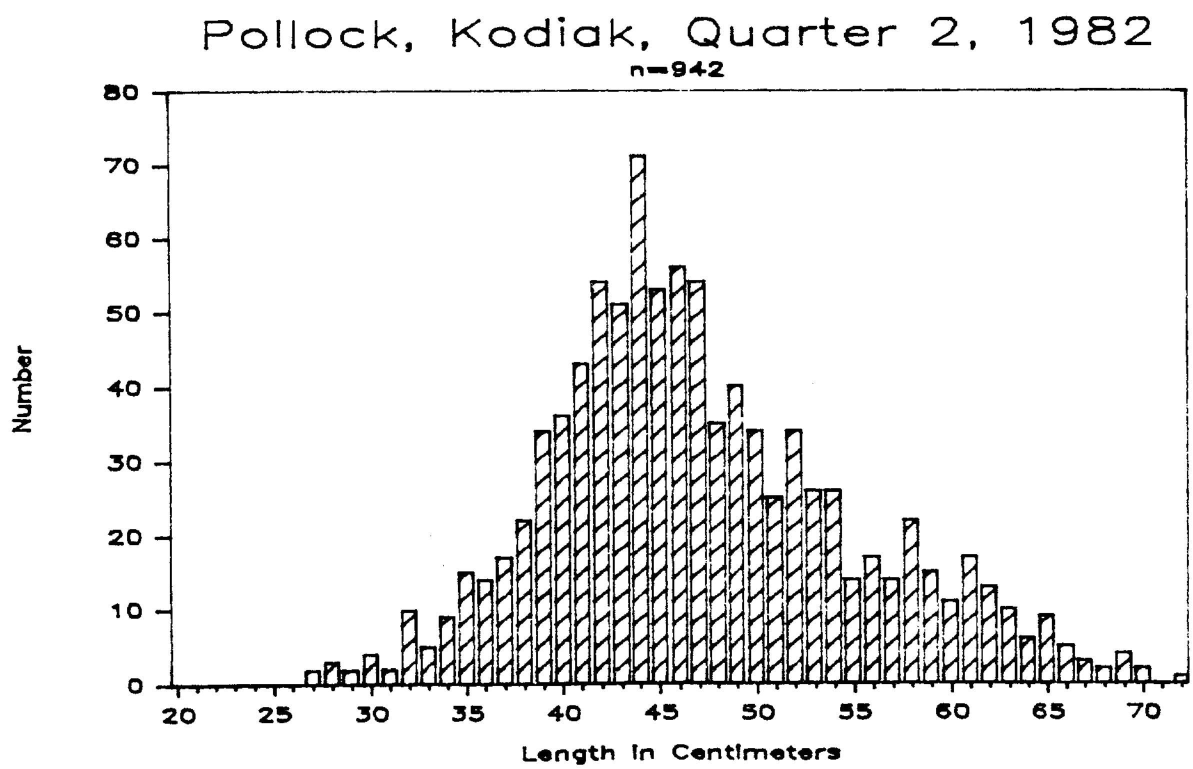


Figure 7. Numbers of pollock *(Theragra chalcogramma)* by size collected from the commercial fishery in the Kodiak area by port samplers and observers during 1982 through 1984.

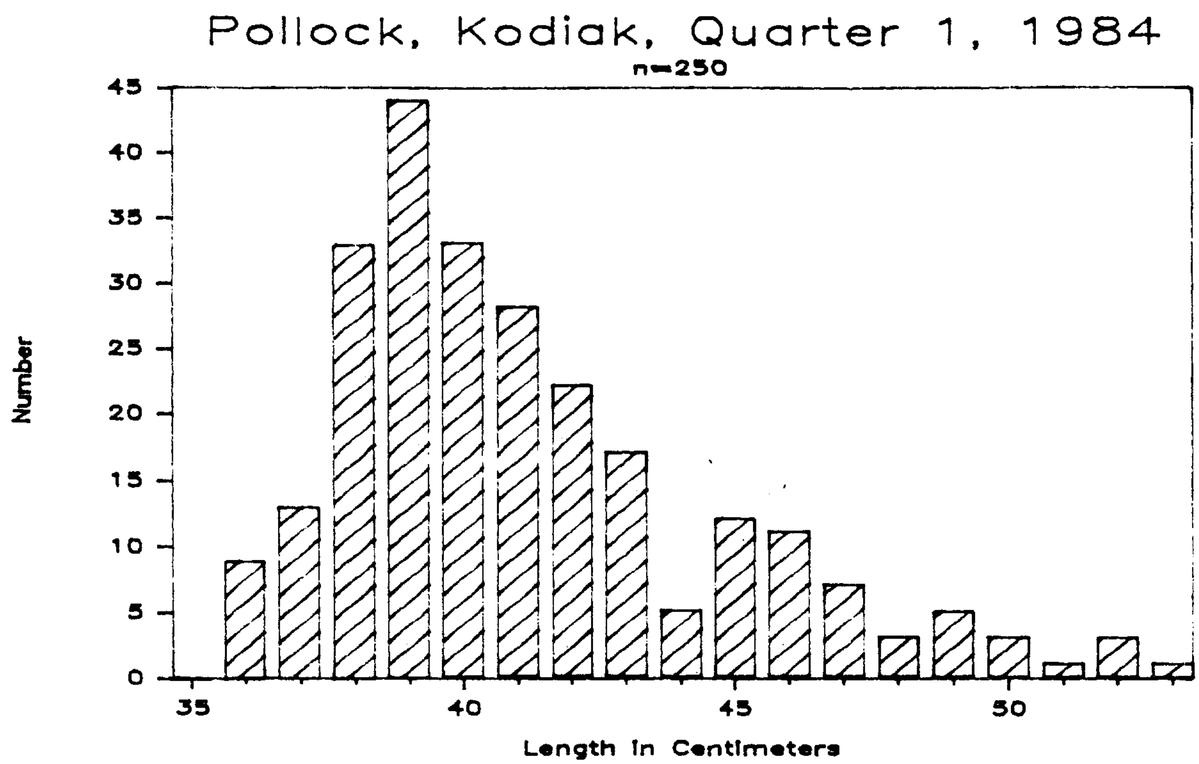
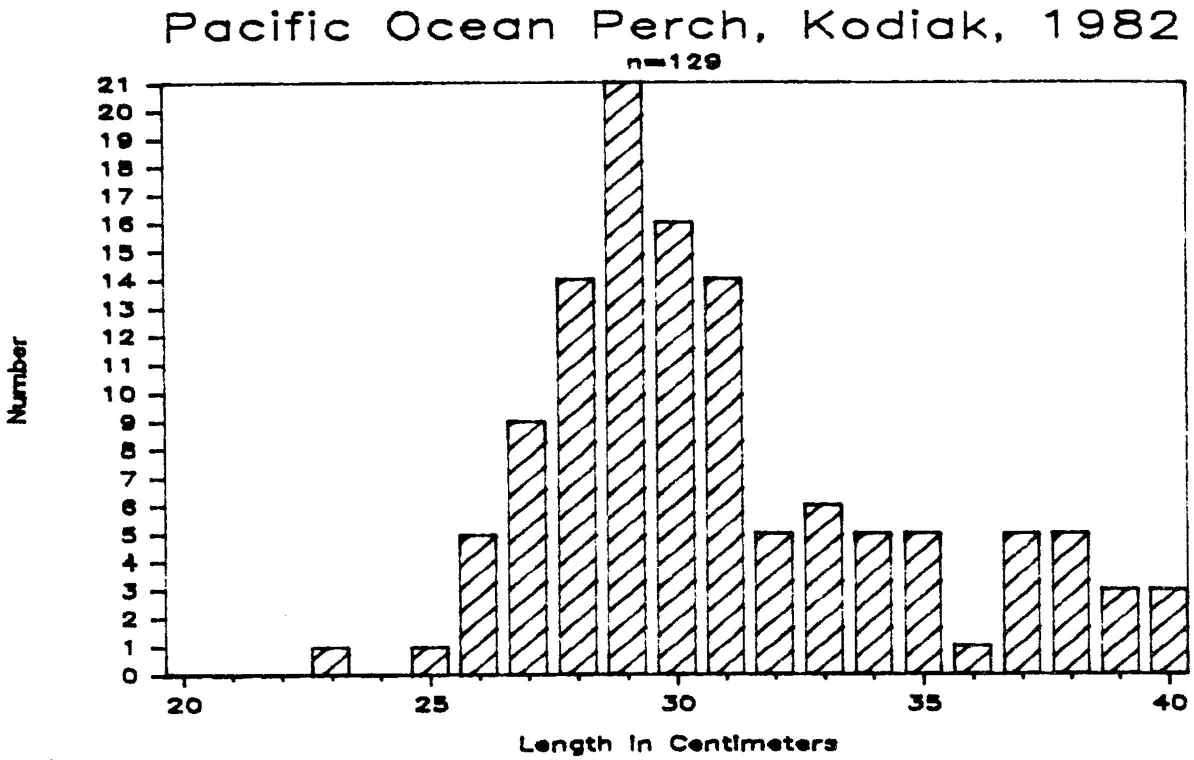


Figure 7. Numbers of pollock *(Theragra chalcogramma)* by size collected from the commercial fishery in the Kodiak area by port samplers and observers during 1982 through 1984.



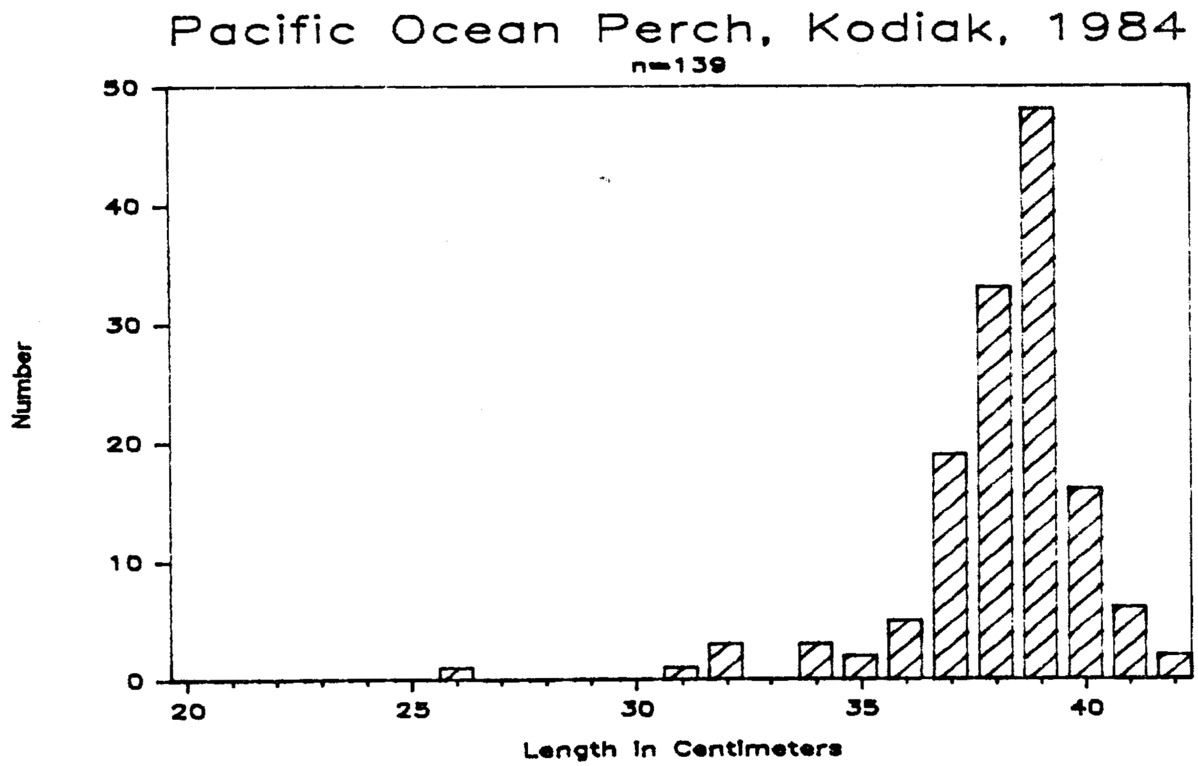


Figure 8. Numbers of Pacific ocean perch *(Sebastes alutus)* by size collected from the commercial fishery in the Kodiak area and from the Bering Sea by port samplers and observers during 1982 through 1984.

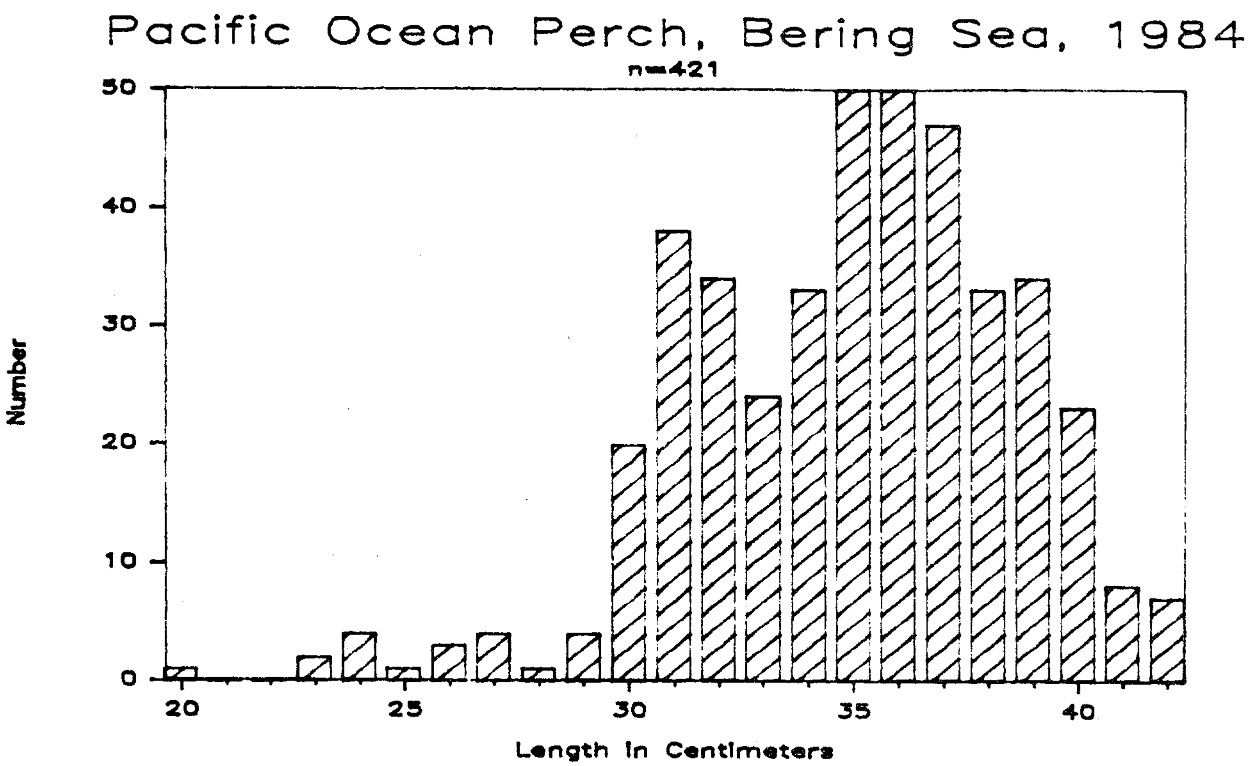


Figure 8. Numbers of Pacific ocean perch *(Sebastes alutus)* by size collected from the commercial fishery in the Kodiak area and from the Bering Sea by port samplers and observers during 1982 through 1984 (continued).

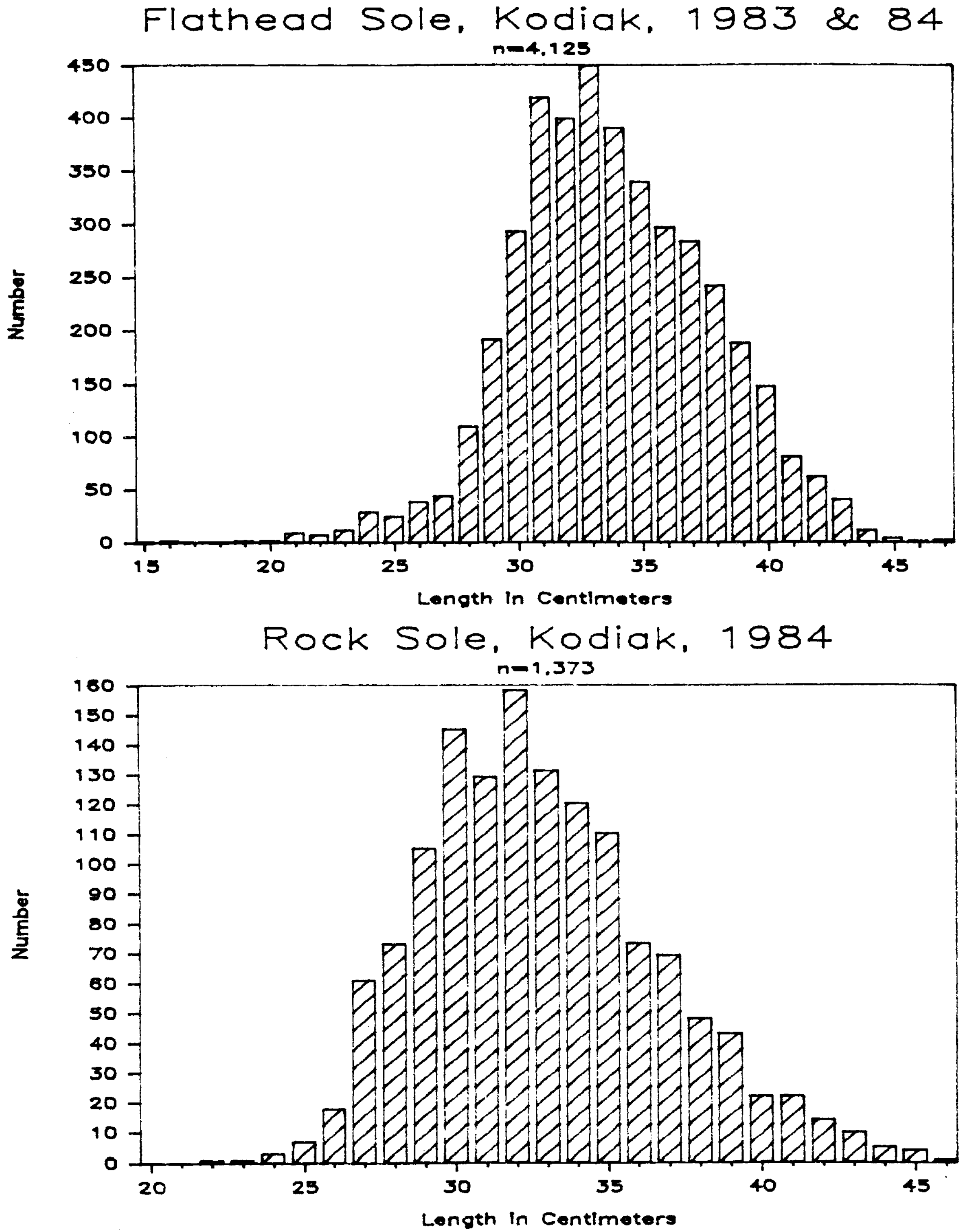


Figure 9. Numbers of flathead sole *(Hippoglossoides elassodon)* and rock sole *(Lepidopsetta bilineata)* by size collected from the commercial fishery in the Kodiak area by port samplers in 1983 and 1984.

incidental to trawling for other species. In 1982 only one longline delivery was made to Kodiak. In 1983 there were a few longline vessels delivering sablefish to Kodiak, and in 1984 the fishery in the Central Gulf (Figure 1) was sufficient to displace the foreign fishery and harvest most of the Optimum Yield (OY). The harvest of sablefish by the trawl fleet in the Bering Sea expanded to almost half of the OY in 1984 (Table 19).

The CPUE data from the longline sablefish fishery in the Central Gulf (Figure 1) increased substantially in 1984 over that in 1983, and the age data indicate that this catch was composed of young fish, mostly ages 6 and 7. The market for small fish in 1983 was poor, and fishermen typically fished deeper than they would have liked that year in order to avoid the small fish and foreign longline gear. It is not clear how much of the recruitment of young fish in 1984 was due to growth and how much was due to changing market conditions. It is clear that the fleet does not utilize the entire age spectrum of sablefish in any given year. If sablefish reside progressively deeper as they age, as is believed, then the shift in age structure between 1983 and 1984 suggests that the fleet utilized that portion of the stock on which catch rates of salable fish were highest in each year. In the future the fishery could be expected to gradually shift deeper in response to successive recruitment failures, and shallower in response to recruitment success, making changes in the fishery difficult to interpret, even with good data, and impossible without it.

From the data collected on age of discarded sablefish, it appears that even age 7 fish are not fully recruited. Stocker (1981) indicates that sablefish recruitment may not be complete until age 14 in the Canadian fishery; however, this evaluation was prior to the improved market for small fish.

Sablefish were usually delivered dressed either eastern cut or western cut. In both forms, the heads and viscera were removed; but in the eastern cut the pectoral girdle is also removed and the belly flap is left intact. The fish were graded by size, and these categories provide some information on size distribution of the catch. From all fish tickets that contained the size grades for sablefish the 1984 landings in Kodiak were as follows:

	<3 lbs	3-5 lbs	5-7 lbs	>7 lbs
Eastern cut	4.3%	35.0%	39.6%	21.2%
Western cut	3.9%	35.2%	39.9%	21.0%

Bering Sea Cod Fishery

Prior to 1980 the only domestic use of groundfish from the Bering Sea area (Figure 1) was for crab bait. One shoreside procesor began buying cod for human consumption during the early months of 1980. There have been a number of shoreside processors since that time and a number of catcher processors. The catch climbed to 37,000 t in 1983 but declined to 34,000 t in 1984 (Table 19). Much of the fishery expansion has been based upon one strong year class of cod (Bakkala and Wespestad 1984).

Table 19. Annual domestic groundfish catches (in metric tons) in the Western Gulf of Alaska and Bering Sea by species group, FMP area, and year: 1975-1984.

Species	FMP Area	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Pacific Cod	Cent. Gulf	83	151	170	609	857	461	795	1,910	4,105	2,148
	West. Gulf	1	10	38	61	0	71	239	292	142	45
	Aleutians	0	0	0	4	2	0	5,259	5,214	4,000	391
	Bering Sea	0	0	15	31	585	2,401	8,979	19,586	37,356	33,856
Pollock	Cent. Gulf	0	0	44	492	1,465	479	561	2,186	117	330
	West. Gulf	0	0	0	0	0	1	0	61	5	0
	Aleutians	0	0	0	0	0	0	58	48	71	12
	Bering Sea	0	0	0	23	0	114	177	88	880	6,669
Sablefish	Cent. Gulf	0	0	0	1	48	19	6	19	251	2,756
	West. Gulf	0	0	0	0	0	1	0	0	10	240
	Aleutians	0	0	0	0	0	0	0	29	25	3
	Bering Sea	0	0	2	0	0	2	2	148	26	1,012
Flounder	Cent. Gulf	4	25	14	86	32	13	52	18	61	240
	West. Gulf	0	0	0	6	0	0	0	0	7	5
	Aleutians	0	0	0	0	0	0	0	0	0	0
	Bering Sea	0	0	2	0	0	44	0	5	3	8
Pacific Ocean Perch	Cent. Gulf	0	0	0	0	0	2	6	2	0	0
	West. Gulf	0	0	0	0	0	0	0	0	7	116
	Aleutians	0	0	0	0	0	0	0	0	0	2
	Bering Sea	0	0	0	0	0	0	0	9	8	1,240
Rockfish	Cent. Gulf	0	2	0	2	5	31	62	10	16	43
	West. Gulf	0	0	0	0	0	0	0	0	4	0
	Aleutians	0	0	0	0	0	0	0	0	0	0
	Bering Sea	0	0	0	0	0	0	0	3	0	38
Thornyheads	Cent. Gulf	0	0	0	0	0	0	0	0	0	1
	West. Gulf	0	0	0	0	0	0	0	0	0	8
	Aleutians	0	0	0	0	0	0	0	0	0	0
	Bering Sea	0	0	0	0	0	0	0	0	0	7
Atka Mackerel	Cent. Gulf	15	0	0	0	8	0	0	0	0	0
	West. Gulf	0	0	0	0	0	0	0	0	0	31
	Aleutians	0	0	0	0	0	0	0	0	0	0
	Bering Sea	0	0	0	0	2	0	0	0	0	0
Other	Cent. Gulf	102	97	96	50	228	364	128	50	44	1
	West. Gulf	0	0	0	13	0	0	0	0	1	0
	Aleutians	0	0	0	0	2	0	0	0	43	0
	Bering Sea	0	0	0	5	25	33	101	0	3,264	0
Totals		205	285	381	1,383	3,259	4,036	16,425	29,678	50,446	49,202

The age frequencies collected from the Bering Sea clearly demonstrate the passage of the strong 1977 year class of cod through the fishery (Table 17). In the first quarters of 1981, 1982, 1983, and 1984 the 1977 cohort comprised 36%, 69%, 60%, and 42% of the landings, respectively. Since ages 7 or 8 have not contributed significantly to the fishery in the past, the age frequency (Table 17) suggests that the 1977 year class should soon decline in importance. Age data from 1985 indicate a strong 1982 cohort in the Bering Sea will be recruiting to the fishery in 1986 and 1987.

The highest catch rates have been in the February-March time period when cod have apparently been on the spawning grounds. The best fishing grounds have been in the area of Unimak Pass near the 100 fm (183 m) contour. There has been an active fishery in Seguam Pass in the Aleutians during the early summer. Generally the summer and autumn fisheries have been dispersed over the shallower waters of the Bering Sea north of the Alaska Peninsula (Figure 1).

Kodiak Fisheries for Cod, Pollock, and Flounder

Recent fisheries for cod and pollock in the Kodiak area (Figure 1) began in 1978 but were primarily seasonal during January through April. There have been a number of processing plants handling cod and pollock, but none of them have operated continuously. There were two state sponsored joint ventures with a Portugese company in 1983 for cod. One purchased cod from late March through late June, and the other operated in the Kodiak area from early November through December and then moved to the Bering Sea in January of 1984.

Various species of Pleuronectid flatfish, other than halibut and all collectively referred to here as flounder, have been landed in small quantities in Kodiak. In 1984 one plant began processing founders and marketing them fresh in the United States.

Considerable controversy erupted over the potential incidental catch of king crab in the flounder fishery. After operating four months the plant had financial difficulties and closed.

Incidental Catch Rates:

Since the catch rate for incidental species varies by an order of magnitude between years, it casts doubt on the validity of the estimates of total incidental catch. It is extremely difficult to make credible estimates of total incidental catch when the incidental catch rate is as variable as it has been for king crab. Also, considering the current controversy over incidental catch, especially of king crab, it is important to provide an estimate in order to bring the size of the problem into perspective.

In the Kodiak area, there were differences in the fishery between years which contribute to the differences in catch rate. In 1982 the bulk of the fishery was targeting on pollock. It was the pollock fishery for which the estimates presented in Table 6 were calculated. In 1984 the fishery targeted cod and flounder, with emphasis on cod (Table 5). Such differences in the fishery from year to year were due to fluctuating local markets for cod, pollock, and flounders. These markets typically supported three to five vessels for a few months. During such fisheries the vessels fished together, and observers typically circulated among the vessels, probably obtaining fairly good information on areas fished and incidental catch rates. There was also a consistent January to April market for Tanner crab bait for which cod was preferred, although other species were also used. The bait fishery was the most difficult of the fisheries to document adequately. It has been much more lucrative than any other trawl fishery; hence, more vessels participate in it, both large and small. The catch is sold at sea, usually without the benefit of scales, so that delivery weights are estimated. The skipper making the sale is responsible for completing and submitting fish tickets.

There are probably two important sources of variation for incidental catch rates, differences in fishing gear and differences in areas fished. Differences in incidental catch rate between target species have been noted, but this is probably more directly related to both differences in gear and area fished. For example, two vessels increased their incidental catch rate of halibut by about three- or four-fold on a few trips by simply altering the net configuration, a change which was made to alter the target species. This change lowered the headrope, reducing total catch but did not affect bottom contact and, therefore, the catch of halibut. The catch of halibut per hour did not change; but the total catch was lower, thereby increasing the halibut catch per ton.

Location fished is extremely important in the incidental catch of king crab. There are only a few areas adjacent to Kodiak Island where king crab have been caught by trawlers in significant quantities. The catch per hour is more than 1,000 times higher in high catch areas than in low catch areas. Although both Tanner crab and halibut have been found nearly everywhere, there are locations for which catches have been routinely higher.

Estimating incidental catch is more difficult with high than with low variability. With variability as high as that associated with king crab catches, estimates must be stratified to control the sources of variation. Estimates made here have not been stratified, thus they are imprecise, although they are not biased.

The estimates of incidental catch provided in this report cannot be considered to be precise because of the high variability, but they do provide a general indication of the magnitude for the portion of the fishery observed.

Discard:

The method of estimating target species discard in this paper is not capable of high precision. There are at least two other potential methods of estimating discard: by the direct counting or weighing and by comparing size frequencies taken before and after onboard sorting. The method choice was based on an assessement of prioritized observer time available and accuracy needed. The discard estimates are imprecise but are adequate for use in managing cod, especially in the Gulf of Alaska where population estimates and reasonable catch quotas are crudely estimated and the stock is not fully utilized.

Rockfish Fisheries

Fisheries for Pacific ocean perch and various rockfish have been virtually nonexistent in the Westward Region until 1984 (Table 19). Processing plants in Kodiak repeatedly attempted to obtain perch but were unsuccessful because vessels were unable to find commercial concentrations. But in 1984 there were significant catches of perch in the Bering Sea and Western Gulf (Figure 1).

The landings of rockfishprior to 1984 from the Central Gulf reported in Table 19 were almost exclusively from a few small vessels taking black rockfish or dusky rockfish by hand jigging. This fishery has taken place off the Kenai Peninsula and in the Kodiak area during the summer and fall of the year. In the Kodiak area it has accounted for about five to 10 tons per year. Some of the 1984 catch of rockfish reported in the Central Gulf (Table 19) was incidental to the increased fishery for sablefish, but the black rockfish fishery has also been growing slightly.

The age samples of Pacific ocean perch from the Bering Sea contain larger year classes at ages 15-16, 23, and 31-34. Although there were differences in the age composition between landings, these larger cohorts are consistent between landings, indicating that they reflect the age structure of the stock. This suggests that recruitment is strong perhaps once every eight to 10 years.

Need for Age Data in Groundfish Management

Some managers have questioned the need for age data, asserting that size data are sufficient for groundfish management. This section is prepared in order to address that question.

The results presented in this report clearly show that size data is much more difficult to interpret than age data, and much less sensitive to changes in the populations which may be caused by the fishery. Long lived species typically have a very flat growth curve so that at any given size a wide range of ages may be present, making age very poorly related to size. In such situations, neither changes in recruitment nor depletion of older fish due to overfishing can be detected with size data.

Age data are extremely valuable in population dynamics work. Age data greatly facilitate estimation of mortality rates, which are directly related to reasonable exploitation rates. Because of this poor relationship between age and size, and the importance of catch at age to the management of long lived species, the Technical Subcommittee of the Canada-United States Groundfish Committee has recommended that sablefish age reading methods be further developed and implemented along with the collection of other vital management data for the sablefish fishery. The extreme need for catch at age information also applies to rockfish fisheries. Available catch at age data for the domestic sablefish and rockfish fisheries within the Central and Western Gulf and the Bering Sea are limited to those presented in this report.

CONCLUSIONS

Areas important to the trawl fishery in the Kodiak area have been the eastern side of Shelikof Strait, Marmot Bay, and the Sitkalidak Island area off the east side of Kodiak. The most important area for the winter cod fishery in the Bering Sea has been in the immediate vicinity and north of Unalaska and Akutan Islands.

Pacific cod begin to recruit to the commercial fishery at age three and are nearly fully recruited at age five.

Discard of small cod by the trawl fleet is not well estimated but appears to be less than 12 to 26% of the catch.

Based on a limited number of samples, Pacific cod at Seguam Pass appear to have a different age distribution from those in the Unimak Pass area and, consequently, may be a separate population.

Sablefish are not fully recruited to the fishery until at least age eight.

Since sablefish have a broad depth distribution and the ages are somewhat stratified by depth, the fishery can be expected to shift to deeper waters and older fish in response to recruitment failure and to shift shallower in response to recruitment success. Such changes can obscure real changes in abundance without good age data from the fishery.

A target fishery for Pacific ocean perch in the Kodiak area utilized younger fish than did fisheries which took them incidentally. This information together with age composition data from the fishery, which have very few fish from cohorts between 1949-1969, indicates that either there were no recruits during those years, that these age classes are not recruited to any fishery, or that cumulative fishing mortality on these cohorts has been virtually 100%.

Strong recruitment of Pacific ocean perch to the stock in the Bering Sea has occurred about once every eight to 10 years.

Observer data indicates that the incidental catch of prohibited species varies considerably, making the calculation of estimates of total incidental catch difficult and controversial.

RECOMMENDATIONS

The program for catch data collection should be continued. Catch data is the most basic information used by fisheries managers.

The skipper interviews and port sampling programs should be expanded to fully develop data analysis capabilities. This program element provides CPUE and biological data, which are important for management.

The observer program should be continued, where it is needed. Efforts to optimize the specific data collection activities, observer effort allocation, and data recording formats should continue. This activity is the only source of information on at sea discard and especially incidental catch which is and will continue to be controversial throughout western Alaska waters.

Age determination activities should continue, especially for the high value, long lived species (sablefish and rockfish). The sablefish fishery is currently worth in excess of $30 million ex-vessel. Although a long lived species, recruitment variability makes the determination of appropriate harvest levels very difficult in the absence of catch at age data. Further work should be placed on optimizing the design of age data collection, since the fleet has diversified into multiple gear and processing components.

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APPENDIX A

Attributes present and structure of data files containing observer and port sampling data.

Appendix Table 1. Structure of observer catch data kept in RBASE 5000 files. The files have two relations, hauls, and catch, each with the attributes noted.

Attribute	Relation: Haul	Relation: Catch
Cruise	x	x
Haul	x	x
Year	x	x
INPFC area	x	
Stat area	x	
Sampling method	x	
Month	x	
Day	x	
Depth	x	
Latitude	x	
Longitude	x	
Hours (Tow duration)	x	
Minutes (Tow duration)	x	
Target species	x	
Gear type	x	
Total catch	x	
Gear performance	x	
Species code		x
Number caught		x
Number in sample		x
Weight of sample		x
Sampling fraction		x

Appendix Table 2. Structure of age data kept in RBASE 5000 files. The files have two relations, AWL and Cruise each with the attributes noted.

Attribute	Relation	
	AWL	Cruise
Cruise	x	x
Haul	x	x
Year		x
Area		x
Month		x
Sample type		x
Species	x	
Sex	x	
Length	x	
Weight	x	
Weight code		x
Age	x	
Age code	x	
Edge type*	x	
Readability*	x	

* Sablefish only

Appendix Table 3. Attributes, field length, and location within records of length frequency data, which is in ASCII files.

Attribute	Field Length	Location in Record
Cruise	4	1-4
Haul	3	5-7
Area	2	8-9
Year	3	10-12
Month	3	13-15
Sample type	2	16-17
Species	4	18-21
Sex	2	22-23
Length	4	24-27
Frequency	4	28-31

APPENDIX B

Examples of data forms used during 1981 through 1984 for collection of fishery related data.

SKIPPER INTERVIEW
-CONFIDENTIAL-

VESSEL ____________

ADF&G NO. ____________

SKIPPER ____________

STAT. AREA(S) ____________

DATE OF LANDING ____________

TARGET SPECIES ____________

NO. DAYS FISHED ____________

NO. SKATES/DAY OR POTS/DAY ____________

SKATES/TRIP ______ HOOKS/SKATE ______

TOTAL FISH LANDED ____________

POUNDS LANDED: (FROM FISH TICKET)

LARGE ______ SMALL ______ #2 ______

TOTAL ______

GEAR TYPE:

LONGLINE:

HOOK SIZE ____________

HOOK SPACING ____________

POT GEAR:

POT DIMENSIONS ____________

POT SPACING ____________

OTHER:

____

____

DATE	FISHING GROUND (compass, loran, name)	AVG. DEPTH (fathoms)	NO. OF SKATES OR POTS RUN	NO. OF TARGET SPECIES LANDED	INCIDENTAL SPECI (approx. lbs/nos

REMARKS:

WHAT KIND OF SYSTEM USED (I.E. HUFF, MUSTAD, SNAP-ON...) WEATHER OR TIDE PROBLEMS?

____

INTERVIEWER ____________

INTERVIEW LOCATION ____________

TRAWL

CATCH COMPOSITION - BOTTOMFISH

Trip No. (1–4)	Haul No. (5–7)	Date: Mo. (8) Day Yr. (13)

Statistical Area (14–18)	Time Towed: Hr. (19) Min (22)	Mean Depth in Fathoms (23–25)

Total Catch Wt. Pounds (26–30)		Total Catch Wt. Kilograms (31–35)		Gear Type (80 81)
	÷ 2.205 =		(1)	

HALIBUT

No. in Total Catch ______ (2)

Length-Width Subs.

No.	Len. (cm)	Wt. (kg)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Subs wt. ______ (3)

No. in Subs. ______ (4)

CRAB

Species: ______

Number in total Catch: ______ (5)

Subsample

Wt. (kg)	No.
(6) Total Subs. Wt. (kg)	(7) Total No. in Subs.

Species: ______

Number in total Catch: ______ (8)

Subsample

Wt. (kg)	No.
(9) Total Subs. Wt. (kg)	(10) Total No. in Subs.

Wt. of Mixed Species Subsample in kg. ______ (11)

CALCULATION OF SAMPLING FRACTIONS

A. If 100% of a species is weighed and measured, the sampling fraction is 1.0000.

B. Halibut:

$\frac{(4)}{(2)}$ = ______ = __.__ __ __ __

C. Crab:

Species: ______

$\frac{(7)}{(5)}$ = ______ = __.__ __ __ __

Species: ______

$\frac{(10)}{(8)}$ = ______ = __.__ __ __ __

D. Total weights of species removed or weighed directly as per A, B, and C above from column 17 (over).

______

______

______

______ TOTAL (12)

E. For species in mixed species subsamples the sampling fraction is

$\frac{(11)}{(1)-(12)}$ = ______ = __.__ __ __ __ (13)

F. If only a fraction f of a species in the subsample in E above is counted and weighed, the sampling fraction of that species is (13) multiplied by f.

______ X ______ = ______

CATCH COMPOSITION - BOTTOMFISH

Page ____ of ____ Pages

A.D.F. & G. (Number) 36 [| | | |]

Vessel: ______________ Observer: ______________ (Initials) 41 [| |]

Incidental Species 1.
All Species 0.
Sample Type: ______________ 44 [ ]

Species Name and Code 45 – 47	Subsample Number (14) 48 – 51	Subsample Weight (kg) (15) 52 – 56	Sampling Fraction (16) 57 – 61	Total Catch Number (14)÷(16)	Total Catch Wt.(kg) (17) (15)÷(16)

LONGLINE
CATCH COMPOSITION - BOTTOMFISH

Trip No. (1–4)	Set No. (5–7)	Date Set: Mo. (8) / Day / Yr (13)

Statistical Area (14–18)	Soak Time: Hr. (19) / Min (22)	Mean Depth in Fathoms (23–25)

No. Skates (62–64)	Skate Length (65–67)	No. Hooks / Skate (68–70)	No. Hooks in Sample (71–74)	Total Catch wt. in kg. (31–35)	Gear Type (80 81)

HALIBUT
No. in Total Catch ____________ (2)

Length-Width Subs.

No.	Len. (cm)	Wt. (kg)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Subs wt. ____________ (3)

No. in Subs. ____________ (4)

CRAB

Species: ____________

Number in total Catch: ____________ (5)

Subsample

Wt. (kg)	No.
(6) Total Subs. Wt. (kg)	(7) Total No. in Subs.

Species: ____________

Number in total Catch: ____________ (8)

Subsample

Wt. (kg)	No.
(9) Total Subs. Wt. (kg)	(10) Total No. in Subs.

Wt. of Mixed Species Subsample in kg. ____________ (11)

CALCULATION OF SAMPLING FRACTIONS

A. If 100% of a species is weighed and measured, the sampling fraction is 1.0000.

B. Halibut:
$\frac{(4)}{(2)}$ = ______ = __.__ __ __ __

C. Crab:
Species: ____________
$\frac{(7)}{(5)}$ = ______ = __.__ __ __ __

Species: ____________
$\frac{(10)}{(8)}$ = ______ = __.__ __ __ __

D. Total weights of species removed or weighed directly as per A, B, and C above from column 17 (over).

____

____

____

____________ TOTAL (12)

E. For species in mixed species subsamples the sampling fraction is

$\frac{(11)}{(1)-(12)}$ = ______ = __.__ __ __ __ (13)

F. If only a fraction f of a species in the subsample in E above is counted and weighed, the sampling fraction of that species is (13) multiplied by f

______ X ______ = ______

CATCH COMPOSITION - BOTTOMFISH

Vessel: ______________ A.D.F. & G. (Number) 36 [ ][ ][ ][ ][ ] Observer: ______________ (Initials) 41 [ ][ ][ ]

Sample Type: ______________ 44 [ ]
Incidental Species 1.
All Species Q.

Species Name and Code 45 47	Subsample Number (14) 48 51	Subsample Weight (kg) (15) 52 56	Sampling Fraction (16) 57 61	Total Catch Number (14)÷(16)	Total Catch Wt.(kg) (17) (15)÷(16)
		.	.		
		.	.		
		.	.		
		.	.		
		.	.		
		.	.		
		.	.		
		.	.		
		.	.		
		.	.		

HAUL FORM

VESSEL NAME ____________________

CRUISE NO	VESSEL CODE	HEAD ROPE (M)	FOOT ROPE (M)	END MESH (mm)	WING MESH (mm)
1	6	11	14	17	22

Page ______ of ______

ROLLERS	Midwtr	DATE			HAUL No	HAUL POSITION			STAT AREA		FISH TIME		Day/Nt	HAUL DEPTH FM	BTM DEPTH FM	AVG SPD Knt	TOTAL CATCH Kg	RETAINED CATCH Kg	BTM TEMP °C	PERF
		Mo	Day	Yr		Lat-Long (1) or	Loran C (2)	1/2	ADF&G	INPFC	BEGIN	END								
23		25	27	29	31	34	40	46	47	52	54 :	58 :	62	63	66	69	71	76	81	84

SPECIES COMPOSITION

VESSEL NAME

CRUISE NUMBER 25

PAGE ____ OF ____

COMMON NAME	SPECIES CODE	SAMPLE		TOTAL CATCH		HAUL NO.	SAMPLE TYPE
		NUMBER	WEIGHT KG	NUMBER	WEIGHT KG		
	1	4	8	12	17	22	30

VESSEL ____________________ PAGE ______ OF ______

INCIDENCE & AGE STRUCTURE

CRUISE NUMBER [1 _ _ _ 5]

SPECIES	HAUL NO 6	SPECIES CODE 9	SEX	LENGTH CM 13	WT KG 17	VIA 21	AGE STRUCTURE			G. DEV. 28	
							O/S	VIAL NO 23	AGE 26		

____

VESSEL

LENGTH FREQUENCY

CRUISE NUMBER [1 _ _ _ 5]

SPECIES NAME	HAUL NO	SPECIES CODE	SEX	SIZE GROUP	FREQ	SPECIES NAME	HAUL NO	SPECIES CODE	SEX	SIZE GROUP	FREQ
	6 8	9 11	12	13 15	16 18		6 8	9 11	12	13 15	16 18

#	cm. size	sex	Tanner crab	King crab	Hermit crab	Snail	Shrimp	Fish	Euphosids	Unident. material	Other (explain)
											Stomach Contents
1	68	m						1			
2	54	m					5				
3	65	m						2			
4	66	F						3			
5	73	m						3			
6	56	F						2			1 blackcod
7	66	F						2			
8	61	F						1	5	X	
9	78	F						3			
10	67	F						2			empty
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

Trip # [illegible]

Haul #'s 10